

Planning a Job Layout

Value of Careful Planning Shown in Economies and Speed on a Small Concrete Job—Plant Laid Out to Secure Most Direct Handling of Materials—Labor Costs Low

By W. W. HAY

THIS is the story of a small job planned as carefully as though it had been a large project. The work was done by day labor, but the entire organization had been working on factory additions and reconstruction for some months previously and many of the men were old contractor's men who had been inherited from an unfinished contract.

The construction involved several small alterations and additions in the large industrial plant of the International Motor Co., at New Brunswick, N. J., including a building 124 by 140 ft. with full concrete basement 93 by 124 ft., a length of about 200 ft. of reinforced concrete retaining wall 11 ft. high, and three large sand bins. The estimated concrete yardage for this work was to be about 2,000 cu. yds., but over 2,200 cu. yds. were actually placed during a period of 145 working days. A building program for three years was laid out by the management, and the entire plant was selected and planned for this program. A fixed location, at least for a year at a time, could be depended upon to serve each project, and in consequence the concrete mixer plant was semi-permanent in its design.

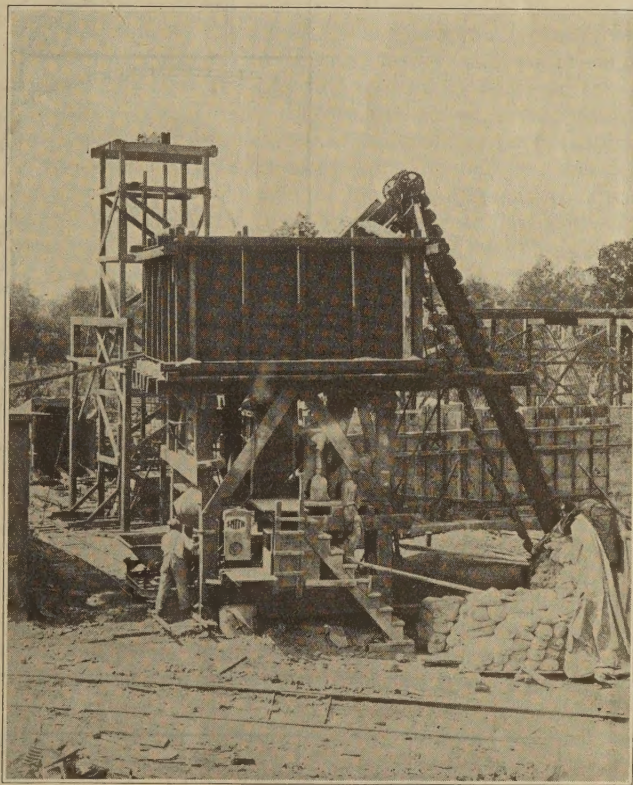
Mixing and Placing Plant

The only vacant ground adjacent to the work to be done during the first year was a triangular slice on the top of the foundry dump, at the level of the main floor of the addition and at track level. The sketch (shown on the next page) shows the salient features of the layout of the work and plant arrangement.

In laying out this work, the principle was followed that all materials should move constantly toward the final location in the structure. By setting the mixer plant adjacent to the railroad siding, it was convenient for unloading cement from box cars directly into the mixer, the delivery of sand and gravel did not interfere with the delivery of any other materials, and at the same time the mixer could be reached by motor trucks for transportation of concrete to other parts of the plant.

There were already available at another manufacturing plant a one-bag tilting mixer, about 600 ft. of 24-in. gauge portable steel track, and three V-bottom dump cars of 1½ cu. yds. body capacity. It was desirable to reduce the concrete labor to a minimum on account of labor union restrictions, and this consideration was the deciding factor in erecting a 50-ton timber bin for aggregate storage and

for charging the mixer. The bins were filled by a 30-ton-per-hour bucket elevator, loaded from a ground hopper into which motor trucks dumped their loads of sand and gravel stone. An allowance of \$1.00 per cu. yd. of concrete for the mixer plant was ample to cover the cost but



The mixer plant. With this plant 2200 cu. yds. of concrete were placed in 145 working days

the saving in labor, at the union rate of \$1.00 per hour, not only paid for the complete mixer plant, but the increased capacity was responsible for further savings.

At the Mixer

The concrete mix was designed for 2000 lbs. per sq. in. ultimate strength at 28 days, and cylinders were broken

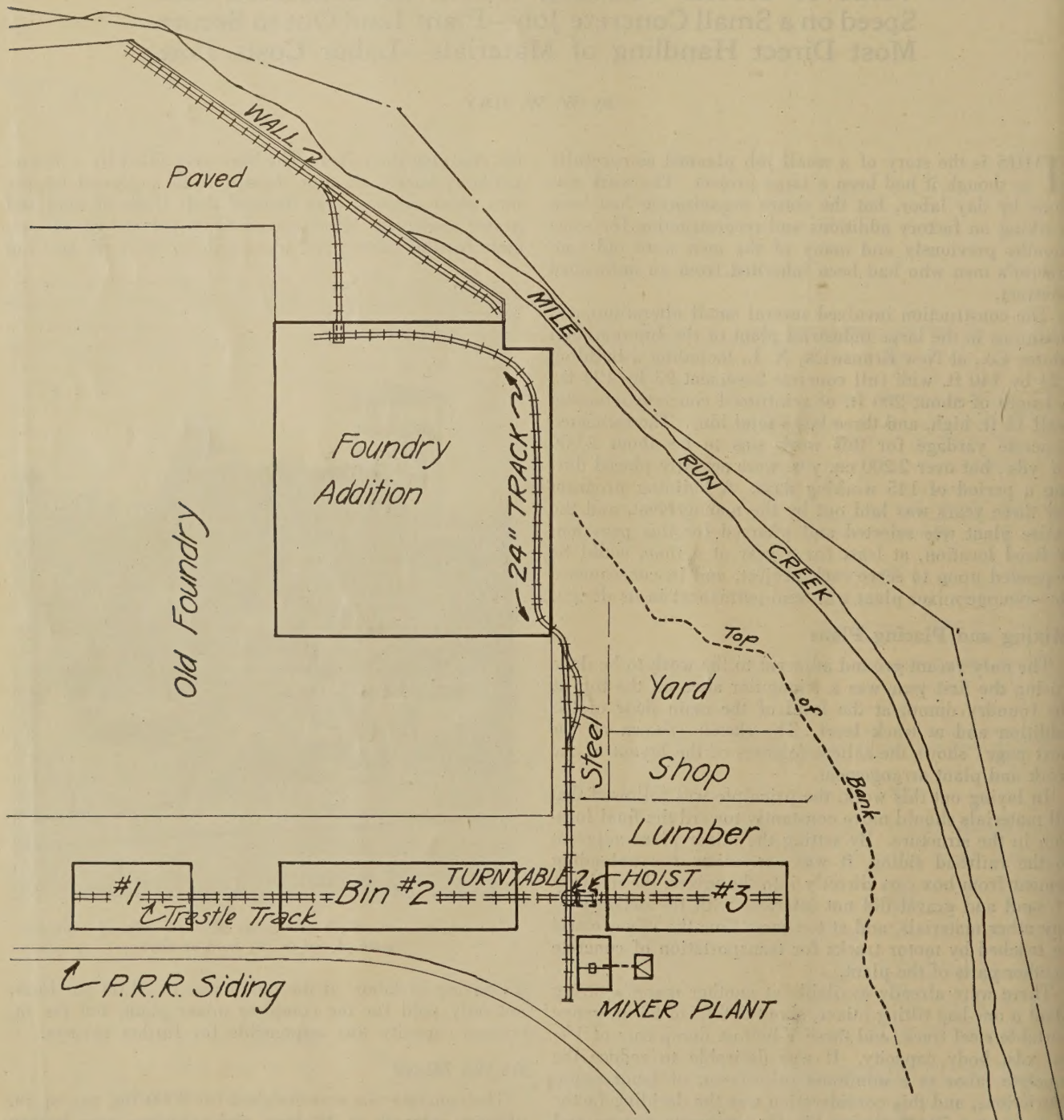
occasionally to check the control. The aggregate used was the same as had been previously used on a much larger project and the only change made was in the cement factor. The mix was about 1:5, using an aggregate of a uniform fineness modulus of 5.0. The cement used was a little more than was necessary, but the consistency was better than usual and resulted in the total elimination of cement finishers and there was no patching to be done.

In operation, a car of cement was arranged for and spotted on the side track opposite the mixer and cement was then used directly out of the car. A car of cement was always kept in storage as a reserve. A proportioning hopper was set on the platform above the mixer and the gate was arranged to be tripped open when the tilting drum settled back into place after being discharged. The water tank for the mixer was a salvaged gasoline tank, into the side of which was tapped an ordinary water glass

gauge, and in addition the overflow pipe was adjustable with a swing joint. Two men were all that were required on the charging side of the plant, as the only manual operation was dumping cement bags and opening and closing aggregate gates and water valve. The mixer was discharged by the man pushing the car being loaded. A full mixing period of one minute was maintained and with three cars being operated, an output of 30 to 40 batches per hour was possible without crowding. In one run of 4 hours, 150 batches (37 cu. yds.) were placed in work at a distance of 350 ft. from the mixer, each car making 12 or 13 trips per hour.

Forms and Reinforcing Steel

The space available for form building and for the steel yard was limited by the top of the 14-ft. dump. The 24-in. track was used for any material which could be handled



Sketch showing job plant layout

conveniently. In addition to handling all concrete direct to the forms, all reinforcing rods, structural steel, brick and masons' supplies, and roofing materials, were unloaded from the standard gauge railway cars onto the 24-in. cars or trucks, and run direct to where used. On the basis of labor at \$1.00 per hour, some of these costs, including unloading and handling 100 to 200 ft. away were:

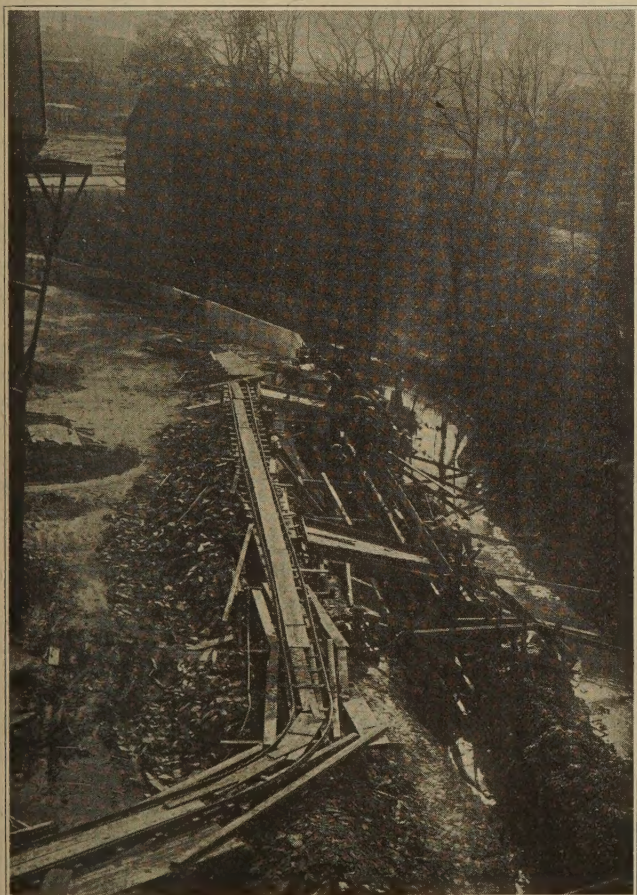
	Per ton
Structural steel (light trusses and channels).....	\$2.43
Reinforcing steel (according to size).....\$2.25 to	3.15
Common brick (\$2.75 to \$3.00 per M).....	2.65
Gypsum (25 bags per ton).....	1.20

Concrete cars containing full batches of about 6 cu. ft. were easily pushed by one man and the 24-in. track was moved about the floor so that the cars dumped directly into place in the forms.

Lumber for forms was stacked next the mixer plant, passed through the portable saw mill for cutting, and the forms were built in the yard adjoining, so that all handling was in the direction of the place where used. Only enough lumber was purchased for one-third of the basement, and was used three times here. The floor panels were then re-built and used for the retaining wall, where they were used 10 or 11 times at a total cost of only 2½ cents per sq. ft. of contact surface.

Concrete Costs

The retaining wall was 14 ft. lower than the track on the building floor and concrete was dumped, through an opening left for a dust bin hopper, into another car which dumped its concrete direct into the wall forms. The total



A 200-ft. concrete retaining wall was included in the project. The sketch on the previous page illustrates the method used to convey concrete to the retaining wall forms

cost of the wall, 11 ft. high, was \$17.50 per running foot, or less than \$30 per cu. yd. of concrete. The average rate for concreting this wall was 18 batches, or almost 4 cu. yds. per hour of pay roll time at a labor cost (\$1.00 per hour basis) of 87½ cents per batch.

Equipment

The sand bins were box-like structures at grade level, the top of the concrete walls being 14 ft. above the rail in front of the concrete mixer. A small gasoline hoist and tower was erected adjacent to the mixer track and on the axis of the bins, and the concrete cars were raised to the top of the walls and run down the center of the bins to dump directly into the walls. The turntable necessary to take the car into the hoist tower was made out of a salvaged motor truck wheel. The timber roof beams for these bins were purchased in advance of need and were used for temporary trestle bents to carry the 24-in. track over the bin tops. As a further example of the care taken to eliminate charges, the gasoline hoist used here was bought as used equipment on a definite resale agreement and was resold within a week after disuse.

This work was all under the personal direction of the author.

Investigation of Permeability of Waterproofing Compounds Under Test

There is now in progress at the Bureau of Standards an investigation of the effects of a representative number of the many commercial dampproofing and waterproofing compounds that are used in practice to decrease the permeability of concrete. Before the actual investigation of the compounds was started a study of the permeability of plain concrete, without admixtures or coatings, was necessary to determine the type of mixture, methods of fabricating, and the curing, etc., which were to be used in the specimens under investigation. To show the relative merits of the various admixtures and coatings, it was essential to develop a concrete that was permeable to a slight degree and then use this mix in all the specimens that contained the waterproofing compounds.

Specimens 4 inches thick were made using 12 mixes of concrete, ranging from 1:1:5 to a 1:4:6 mix and tested for permeability. The water-cement ratio and the size grading of the sand and gravel were varied for each of these mixes. The tests on these varied mixes showed that a mix of dry consistency was too permeable, but a mix which was wet enough to be workable was practically impervious. The medium flow between these two extremes, which allowed a small amount of water to pass through the specimens, could not be obtained by control of the water alone, so the thickness of the specimen was changed.

It was finally decided to use a specimen 2 inches thick, consisting of 1 part of cement, 3 parts of Potomac River sand, 6 parts of ¼ to ⅜ gravel, and a water-cement ratio of 1.175, as a standard. This mix is put into a cylinder mold 5 inches in diameter and bumped on the flow table instead of puddling or tamping.

After a 7-day curing period in the damp closet the specimens are ready for test. They are placed between two pipe flanges carrying rubber gaskets and tightened so that there is no leakage around the edges. A water pressure of 20 lbs. in.² is then put upon the specimen, and the amount of water passing through it in a specified time is recorded. The permeability will be determined at various times up to one year, but the pressure on the specimens will be maintained at 20 pounds at all times.

Expanding the Market for Concrete Masonry Through National Advertising

*National Co-operative Advertising Campaign for Concrete Masonry
Begun by the National Concrete Products Association—"500,000,-
000 Units by 1933" Is the Slogan*

THE past few years have witnessed a large increase in the sale of concrete masonry. The use of this material in all types of structures has increased side by side with the progress in quality of the product and improved marketing methods. The limiting factor to a wider use of concrete masonry lies in the rapidity with which the general public is informed and accepts it as one of the most desirable building materials.

Public knowledge of the advantages of concrete masonry has depended in the past on the merchandising activities of the individual concrete products plants. In cities where the manufacturers have employed live, aggressive salesmen, considerable information has been carried to such sales prospects as these men have been able to reach.

Obviously the amount of information and the number of prospects covered by personal contact with the salesmen is limited. Furthermore, the salesmen have found serious sales resistance to concrete masonry due to lack of information by their prospects. It has been clearly established that one of the most important needs for widening the market for concrete masonry is public understanding of the product and its merits.

A National Advertising Campaign

To meet this need, a national advertising campaign for concrete masonry opened early in June. It is being conducted for the entire industry as a special activity of the Concrete Products Association. "An annual market for five hundred million units by 1933" is the aim of the campaign, which is planned to educate everybody to two outstanding facts about concrete masonry:

- (a) Concrete masonry is a quality building material, produced under standard industrial conditions by reliable manufacturers;
- (b) In every type of building there is a place where concrete masonry is better than any other material.

Widespread publicity will be given to the advantages of concrete masonry in advertisements published in leading magazines having national circulation. By educating the building public to the quality of concrete masonry and its desirability in all classes of buildings, sales resistance will be broken down and popular demand created for the product.

All advertising will present concrete masonry as such, without reference to size or shape of units or to the aggregate used in their manufacture. The definition of the product which will govern all publicity is as follows:

"The term concrete masonry is applied to block, brick or tile building units molded from concrete and laid by a mason in a wall. The concrete is made by mixing port-

land cement with water and other suitable materials such as sand, pebbles, crushed stone, cinders, burned shale or slag."

Magazines in which the advertisements will appear have been carefully selected, in order to reach the prospects who are most influential in the use of concrete masonry. Journals read by bankers, architects, real estate men, builders and contractors will be used for publishing those facts about concrete masonry that appeal to these groups. To reach the general public, or so-called "ultimate consumer," a series of ads will be printed in magazines having a general circulation.

The Committee on National Advertising, in charge of the campaign, consists of representatives of all the various interests in the concrete masonry industry. Included in this group are block producers, tile producers, and users of one or more of all the various aggregates at present on the market. They have united in establishing a broad, far-reaching purpose of the campaign that is paramount to the petty differences in selling points between the various units at present being manufactured.

Committee on Advertising

Members of the committee are: Chairman, D. R. Collins, Milwaukee; secretary, H. E. Buchholz, Oak Park (Illinois); assistant secretary, T. H. Merriam, Chicago; Austin Crabbs, Davenport; E. W. Dienhart, Cleveland; W. R. Harris, Milwaukee, and A. G. Swanson, Omaha.

"There is one idea on which all the leaders in the industry have agreed for years," a statement issued by the committee asserts. "That is: Concrete masonry should be widely popularized by national advertising. Every manufacturer in the industry will benefit. Co-operative educational advertising is one of the most progressive steps ever taken by the industry."

Month's Construction Passes Marks of Previous Years

The backlog of construction contracts signed last year served to maintain construction activities at a high comparable level during May despite recession in the rate at which building contracts are being signed this year, according to a statistical study just completed by the Associated General Contractors of America.

The volume of construction performed during May, as indicated by shipments of basic construction materials, rose 18 per cent over that of April and was the greatest for that month in any year on record. This despite the fact that building contracts have declined 14 per cent during the first four months of this year as compared with the first four months of last year.

Low Cost Form Work

Secured by

Complete Planning and Careful Detailing

A Description of the Methods Used in Detailing and Scheduling the Large Volume of Form Work Used in Constructing the New Daily News Plaza in Chicago—A 26-Story Fireproofed Steel Structure with Concrete Floors—Form Fabrication Planned to Permit Work on Any Part of Building—Some “Kinks” That Cut Costs

By GEORGE B. BOSCO

IN FABRICATING the forms for a construction project as large and as involved as that of the new Daily News Plaza in Chicago, a carefully predetermined plan of operation is a first requirement to efficient, low cost work. The job was further complicated because of the limited bench space available, especially at the beginning of the work, and because of the irregular design of the building.

A form panel “erection plan,” based on the steel erection diagrams was evolved which simplified the work tremendously. The entire work was administered from the form detailing office, three blocks away from the job, and all questions and problems were taken care of by telephone communication between the job and the office.

More than three-quarters of a million square feet of forms were required—550,000 sq. ft. in the beam forms and 225,000 sq. ft. in column forms.

On a job involving such a great number of individual panel units, even a slight saving in effort on each panel was multiplied many times for the entire job. An instance of such economy, which saved the boring of hundreds of thousands of holes will be described later.

The Daily News Plaza

The Daily News Plaza is Chicago's first large air-rights building. It is constructed partly over the tracks of the C. M. & St. P. Ry., where they approach the Union Station from the north; in fact, some of the station platforms extend under the building. Only a corner of the building proper extends over the tracks, though two four-story wings extend entirely over the track area. Because the tracks under the building constitute the approaches to the station, they spread to provide space for the platforms. The result is an irregular layout which introduced some unusual design problems. The track layout governed the column spacing and the framing was designed to fit the column spacing.

The building proper is 26 stories in height, extending 389 feet along Canal St. for the full length of the structure. The width of the tall portion of the building is 100 feet up to the sixth floor, above which there are small setbacks. Extending from the building proper at each end are the two four-story wings. The first six floors of the building are occupied by the Chicago Daily News offices, and space is provided on the second floor to house the large presses.

All of these features introduced design problems the solution of which required a large amount of special form work. As previously mentioned, the building is of steel

construction with concrete fireproofing and concrete floors.

Because of the limited space available at the job, the beam and column forms for the first four floors were made up at the lumber yard, 3 miles from the job. After the first two floors of the new building were poured, the carpenters' benches were moved to the job and the balance of the forms were fabricated there.

How the Forms Were Detailed

All forms were detailed to exact dimensions, including all beam cut-outs, pockets, etc. Every floor was detailed separately and an effort was made to reuse form lumber wherever possible. When the job was completed, a check-up showed an average reuse of about four times—a good record for a job of this kind.

The form detailing office was supplied with blueprints of the steel erection diagrams and of the architect's drawings. With these as a basis, a complete set of form detail sketches was worked up.

The steel erection diagram plan of numbering was adopted for the form work also, i. e., each beam form was marked with the same identification number as the beam or column on which it was to be used. As the steel members were prominently marked with their identification numbers, there was no confusion in selecting the form panels belonging to each structural member.

The steel erection plans divided each floor in the building into bays designated alphabetically from north to south and numerically from west to east. The structural members in each section or bay were then designated by the identification mark of the column immediately to the right.

Form detail sketches were made on tablet sheets similar to those shown in Figure 1 and Figure 2. Carbon copies were made of each of these sheets—the original going to the job for bench makeup and the carbon being retained in the office files for reference. Each detail sheet carried two numbers, one, the number of the member according to the steel erection diagram, and two, the file number of the drawing.

Figure 3 illustrates the index sheet on which all reference data regarding the form detail sheets were recorded. Separate beam and girder index sheets of this type were prepared for each floor, the floor number being placed at the top of each sheet as shown.

The sheets were filled out as follows: Under the heading

	√	Section	(1) Beam No.	Beam Bottom	Beam Side	√	Section	(2) Beam No.	Beam Bottom	Beam Side	√	Section	(3) Beam No.	Beam Bottom	Beam Side
1															
2															
3															
4															
5															
6															
7															

Fig. 3. The beam index sheet



Fig. 4. Showing beam forms and joists. Note the diagonal spacing of the battens and the absence of bore holes

"Section," the section number, identifying the location of the member, was placed. Under "Beam Number" (or Column Number) the beam number (or column number) as shown on the steel erection diagram was placed. Beam bottom forms were detailed on a separate sheet and the office file numbers of the sheet on which they were detailed were recorded on the index sheet under the heading "Beam Bottom." The office file numbers of the sheets on which the beam sides were detailed were entered under the heading "Beam Side." The same general plan of indexing was used for column forms also.

This index sheet proved invaluable. Whenever questions regarding any form detail arose, the detailing office was called on the phone and the reference as given on the index sheet was given to designate the detail sheet in question. The office then referred to its carbon copy of the detail sheet and all the information needed was immediately at hand. In this manner practically every question that arose during the entire eight months required to complete the job was quickly and satisfactorily settled over the telephone. This record is the more remarkable because changes



Fig. 5. Joists supporting the soffit boards for the concrete beams were hung with strap irons and beam clamps placed at each end of the steel beams.

in plans, interference of other construction activities, etc., made it necessary to fabricate form work for several floors at the same time.

Another time-saving "kink" that was developed on this job was to paste sections of the blueprints showing the architectural details referring to each member on a separate sheet which was numbered the same as the form detail sheet to which it referred. This made it unnecessary to page through a bulky set of architectural drawings each time and it provided an absolute tieup and check between the architect's drawings and the form detail sheets.

Method of Hanging Forms

The method used to hang the forms from the steel members was devised by the author. The equipment used consisted of band iron hangers and soffit clamps. No scaffolding was necessary. Just before the floors were poured shores were placed under the stringers.

Saving in Boring

The usual practice in work of this kind is to bore two holes in the beam bottom form for each hanger. In this

Personnel

The architects for the Daily News Plaza were Holabird & Root. Joshua D'Esposito was consulting engineer for the Daily News Co. Hegeman & Harris were the general contractors for the super-structure and Adolph Lindstrom was sub-contractor on the concrete work. The author designed and supervised the form work for the sub-contractor. Lumber was supplied by the Bishop Lumber Co. and form accessories by Fisher & Hayes Rope & Steel Co.

Slag Association Undertakes Simplification

At their twelfth annual meeting on June 6th and 7th, members of the National Slag Association voted to accept the services of the Division of Simplified Practice of the Department of Commerce to co-ordinate the size requirements of existing specifications. A comprehensive survey of the industry will be begun immediately.

At an early date the association will begin a ten-year

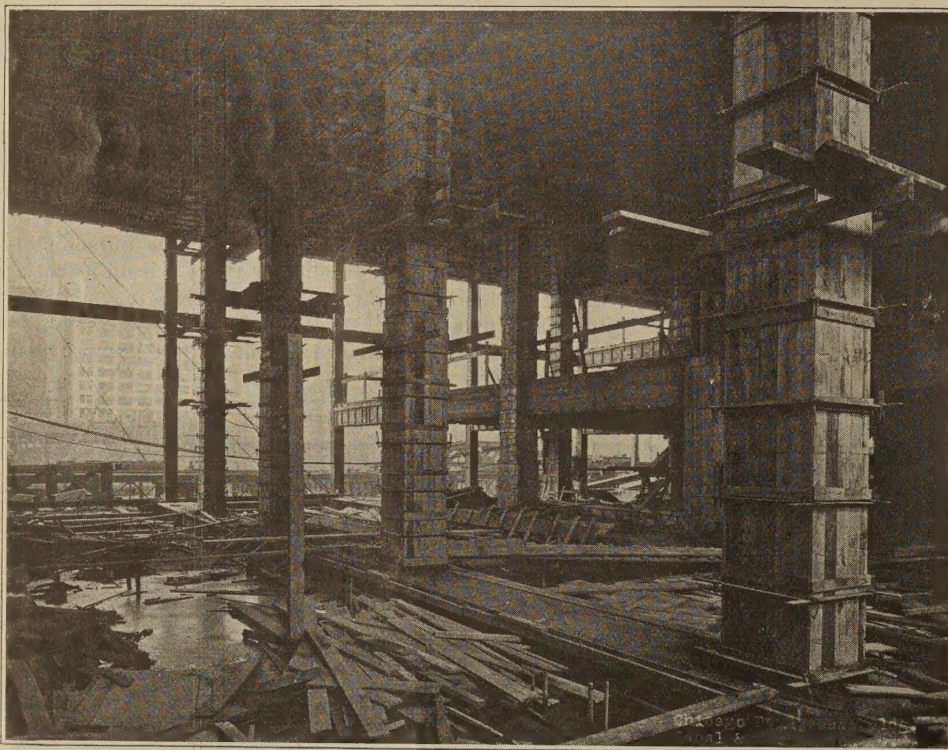


Fig. 6. Showing column and floor form details in the two-story press room.

case, only three sets of holes were bored in each bottom panel—one at each end and one in the center of the panel. The battens were fastened diagonally on the bottom form and the band iron was brought down from the steel beam over the battens and back up on the other side. The method is clearly shown in Figure 4. This little "kink" saved the boring of more than half the holes usually required in a job of this kind. When the holes needed run up into the hundreds of thousands, the savings that result are of importance.

Joists supporting the soffit boards for the concrete beams were hung with strap irons and beam clamps placed at each end of the steel beams as shown in Figure 5. They were spaced on 4 ft. centers. Two-by-ten joists were used, which were found to be strong enough to carry the pans, reinforcement, etc., until the concrete was placed.

test program in the laboratory of the Bessemer Limestone and Cement Company representing an extension of investigations being accomplished by Committee C-9 of the American Society for Testing Materials.

The following officers were elected to succeed themselves: C. L. McKenzie, president; C. E. Ireland, vice-president, and H. J. Love, secretary-treasurer.

Quantity Surveyors Meet

The fourth annual convention of the American Institute of Quantity Surveyors was scheduled to be held at the Book-Cadillac Hotel, Detroit, Michigan, June 24th to 26th. Selling of the quantity survey idea was to be the main theme of subjects to be brought before the meeting.

Modernizing a 1915 Products Plant

Milwaukee's Oldest Concrete Products Plant Makes Radical Changes—Entire Plant Remodeled and Brought to 1929 Standards—"Before and After" Descriptions—How the Work of Rebuilding Was Accomplished

By "SPEC" COLLINS

IT probably sounds topsy-turvy to say that when we remodeled our plant we started at the top and built down. But that's almost exactly what we did. Practically the first thing we did was to tear out a section of the roof. But that's getting ahead of the story.

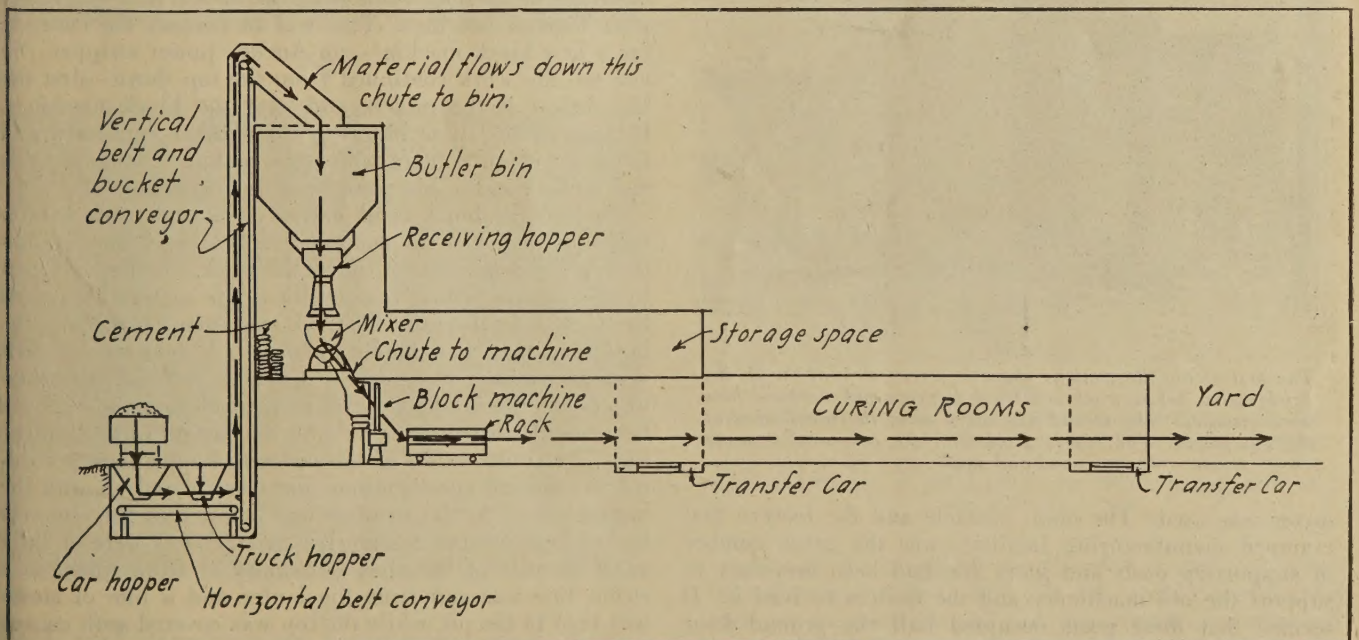
The A. W. Friske plant was built back in 1915. At that time it was the largest and most modern plant in Milwaukee County. Everything was provided, or provided for, to make it a model of efficiency. And it always was an efficient plant, probably then nearly as efficient in its way as it is today. But a 1915 plant and a 1929 plant are radically different.

The Old Plant

Let's describe the old plant and its equipment first. The principal commodity manufactured was concrete block. In fact the first 16-in. block made in Milwaukee was made in this plant. Milwaukee was long a stronghold of 20-in. long block and the change to 16 in. was a radical departure. Concrete in the old plant was originally mixed by continuous mixers. One of these original mixers was still in service when the plant was changed the past winter. Concrete blocks were manufactured on two Zophy stripper block machines, a Milwaukee product, and a Papke ma-

chine manufactured at Minneapolis. A Hayden stripper was used to manufacture such specials as chimney blocks. Concrete for the Hayden and the two Zophy machines were supplied by a Kent continuous mixer. Cement to this mixer was fed from a small auxiliary bin located on the second floor of the plant, as was sand and stone. Stone (limestone screenings) was received by truck from a local quarry and dumped at the rear of the building. Sand was received by car or truck and stockpiled at the rear. This was mixed in proper proportion before being elevated to the small overhead hopper. This Kent mixer fed onto a platform in front of the machine and the concrete was hoed into the mold boxes. Blocks were tamped by two Anchor tampers of the suspended type. A word about these tampers; a search was made to determine what money had been spent on repair parts for them during their 12 years of service and the amount was found to be mighty small. In fact they operated almost up to the minute that the section of the plant they were located in was dismantled in the modernization process.

The Papke machine was installed in the winter of 1925-26. The concrete for this machine was supplied by a 9-ft. Ideal mixer equipped with a Strenes metal liner. The batches for this mixer were measured by a 9 cu. ft. pit and



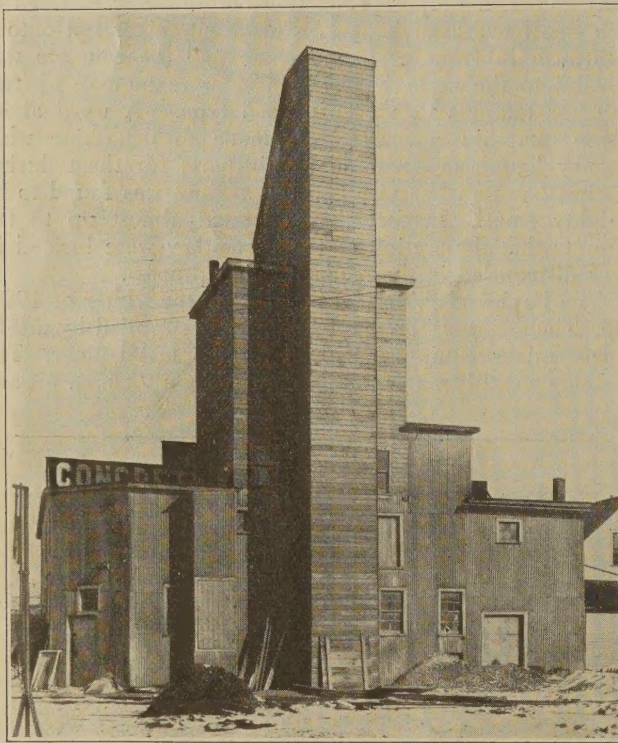
Cross-section of the new 1929 plant of the A. W. Friske Company, showing the shop flow line

the proportioned mix elevated to the mixer by a bucket conveyor. This pit was located in the floor in front of the mixer which was, in turn, directly in front of the block machine. Mixed concrete was elevated to the feed hopper of the block machine by a chain drag. This arrangement, while handy, occupied a great amount of floor space that was needed for the manufacture of specials such as sills, lintels, pier blocks, chimney and pier caps.

To supply concrete for these specials a 5-ft. Blystone



Before



After

The first of the illustrations above is a rear view of the A. W. Friske plant before track and truck hoppers and overhead bins were installed. The second was taken after the installation of the equipment. The bin is divided in the center to separate sand and stone

mixer was used. The main obstacle and the feature that cramped manufacturing facilities was the great number of supporting posts and piers that had been necessary to support the old machinery and the devices to feed it. It seemed that these posts occupied half the ground floor space of the plant. Another objectionable feature that was to be eliminated in the plan of modernization was that of outside and ground floor storage of aggregate. As the

plant is operated 12 months of the year by this method of storage, winter operation is decidedly inconvenient.

New Aggregate Handling Methods

So we started at the top to build down. I'll take that back, though, for the first operation was that of placing concrete piers on the ground floor to receive the steel supporting members of a Butler steel bin to hold aggregate. It is the belief of the writer that in plant design as it is practiced today the primary requisite is an overhead bin of some sort for the handling and storage of raw material. The Butler bin, which is manufactured at Waukesha, Wisconsin, was selected because of the writer's familiarity with this bin after having studied a number of installations in this vicinity.

Up to the day that the workmen appeared to install the bin unusually mild weather had prevailed. However, the morning they arrived the thermometer started to drop and the first below-zero wave of the season appeared and remained as long as they did. This apparently did not daunt them, for in five days the bin was completely installed. Instead of the measuring device present on most bins, this one was equipped with a weighing device so that all material could be weighed—that is all material except cement, which is weighed for us at the factory. This weighing of materials we felt was a definite step in advance in concrete products plant proportioning and would give us a more accurate check on the materials we were using than any other method we might use.

Increasing Floor Space

With the bin in place the work of remodeling started in earnest. The continuous mixer which had done yeoman duty for many years was discarded. Posts were torn out with abandon and in their place, to support the second floor, long steel beams and columns appeared. It was remarkable what a change this made in the plant. It seemed as if the floor space had actually been tripled. The 9-ft. mixer was swung up to the second floor and into place over the spot where the Papke machine, which it was to continue to feed, was to stand. This was in a position directly under the feed spout and the scales of the bin.

Beside it was placed another Ideal mixer equipped with a Strenes metal liner—this being the new type 14-ft. mixer with Timken bearings. This was to furnish the concrete for a new block machine—an Anchor junior stripper. So you see the work continued from the top down—first the bin, below it the mixers and next the block machines. During all this time bitterly cold weather continued and the crew of carpenters who were making changes inside and closing in the bin were severely handicapped.

To feed the bin a combination truck and truck hopper was constructed. I say combination because it has in addition to the compartment under the track, another adjacent to the factory which is convenient for material received by trucks. As the railroad track was some 16 ft. from the building, this was made possible. A bucket and belt vertical elevator designed by Coyle & Roth of Minneapolis, feeds the hoppers. This vertical elevator is fed by a horizontal belt conveyor running the length of the hopper pit. The construction of the concrete hopper was according to railroad specifications and was carried on with the utmost care. As the weather was below zero the concrete had to be protected constantly. Salamanders were of little avail because of the close proximity of form work, so a steam line was run from the boiler and a line of steam was kept in the pit, while the top was covered with canvas until the concrete had thoroughly set. A close inspection when the forms were stripped failed to reveal a single frozen spot.

Installing the Block Machines

Now, with the bin erected and enclosed and the mixers in place, the Papke machine was moved to its footing on the first floor directly under the 9-ft. mixer. The Anchor machine had arrived by that time and was moved to its place under the 14-ft. mixer. Rails were then laid adjacent to these mixers and the entire floor repaved. As a large space had been created at the east end of the floor for making specials, the small Blystone mixer was moved over to it and connected up. The old Hayden stripper, which was still to do duty as a chimney block machine, was moved to the west side of the plant and a connecting chute with the one feeding the Papke machine rigged to it.

A novel feature of this arrangement is that all pulleys, hangers and shafting, with the exception of that used to drive the Blystone, are located on the second floor and the block machines driven through the floor. Each unit of mixer and block machine has its own motor so that if a breakdown occurs in either unit it does not cripple the other. The conveyor motor is located above the top of the bin and provides a semi-direct drive to the vertical conveyor, which in turn drives the horizontal conveyors by chain and sprocket.

Last summer when announcement was made that a plant in Flint, Michigan, had, in 10 hours running time, produced over three thousand 8 by 8 by 16 units on a small machine, we in Milwaukee became intensely interested. A

trip was made to Flint and the figures substantiated. A stripper equipped to make 8-, 10- and 12-in. block was selected. As all rock faced block in the Milwaukee market are made on stripper machines, the machine selected was so equipped.

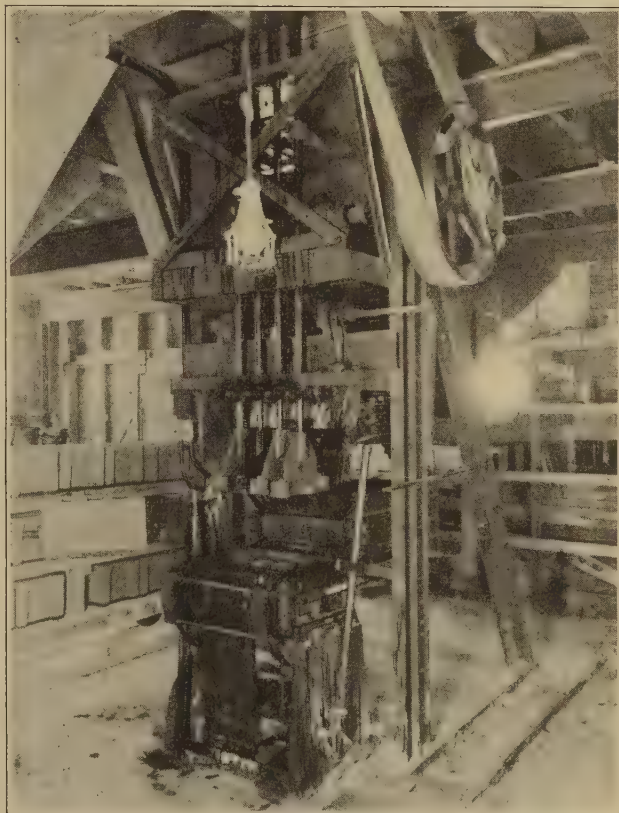
In addition to the standard equipment that regularly



Before

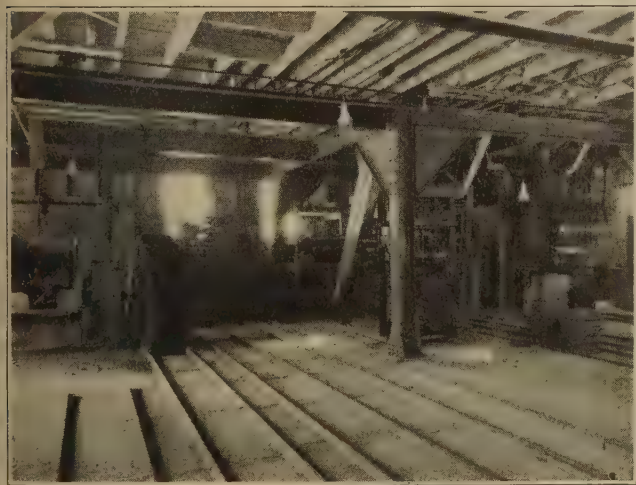


Before



After

The old plant included the two block strippers shown in the upper illustration and the one to the left, used for chimney block and solid 5-in. slabs. The new stripper, shown in the lower illustration, is fed from a new 16-ft. mixer located on the floor above



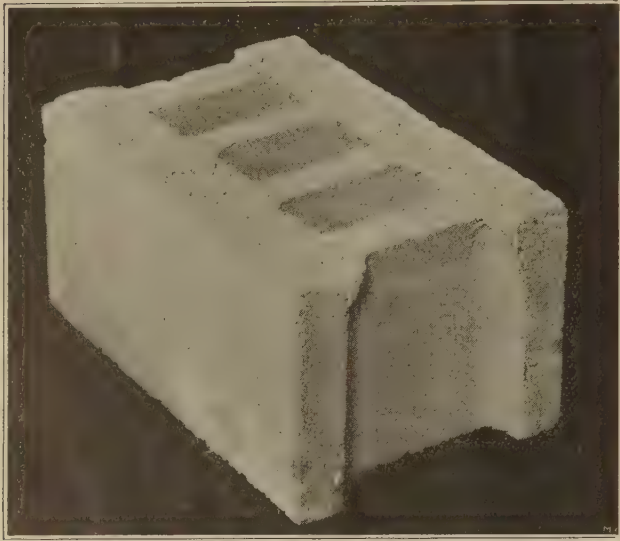
After

The result of modernization. Posts, necessary for the support of old machinery, took up a good part of the space and cramped working quarters. The additional floor area secured and shown above was gratifying to the management

comes with the machine, an extended feeder and power strikeoff was included. This, we felt, would considerably speed up the machine and give it a greater operating efficiency. As we have a comparatively small yard, the car system of handling blocks to the curing room is still in use and tracks for trucks to receive the block are run as close

to the machine as possible. On the Papke, offbearing can be performed either to right or left and tracks are placed accordingly, one close to the machine and one for a reserve car adjacent to it.

As can be seen from the accompanying illustration, the



An unretouched photograph of the 8 by 10 by 16 in., 50 per cent air space block

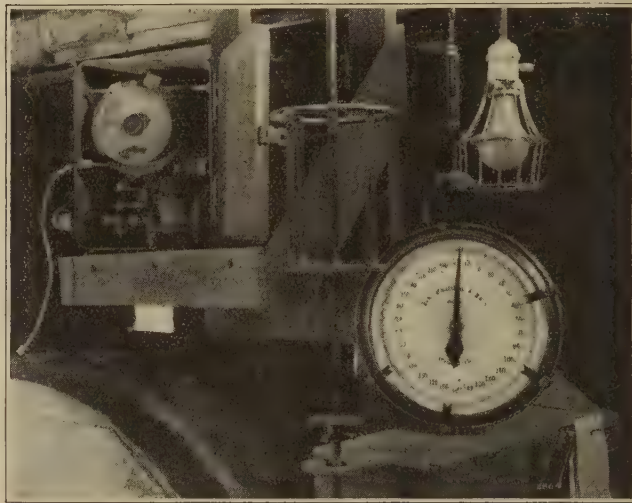
remodeled plant contains much more working space than the old and gives much more room for work on specials.

A New Type of Block

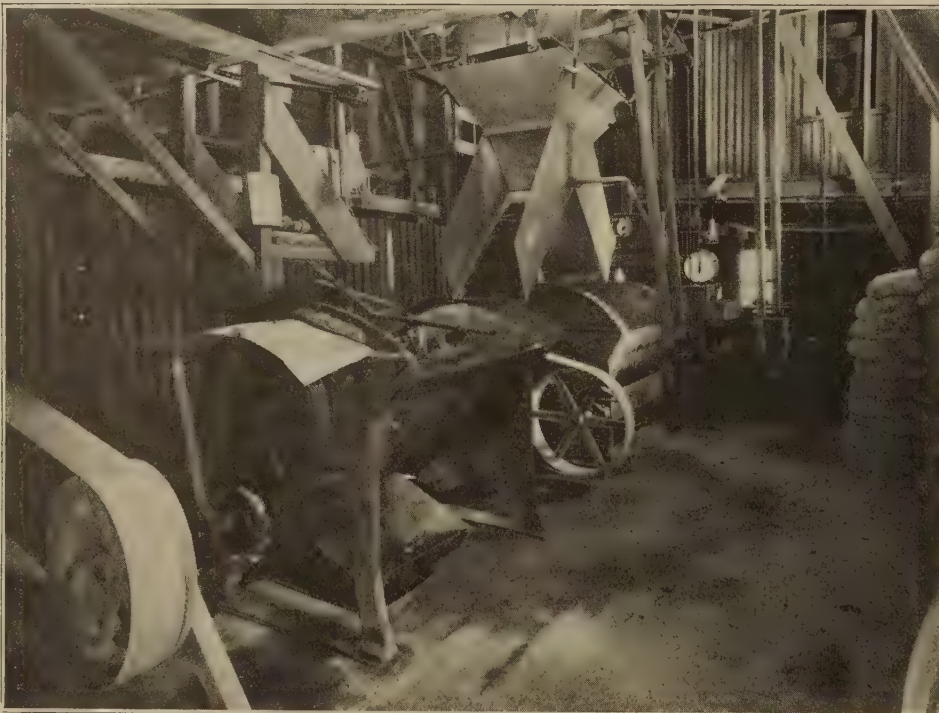
The design of the blocks made on these machines is somewhat different than anything else in Milwaukee County. In the past a single core unit with a mortar bed of approximately 3 in. was manufactured in the Friske plant. This wide mortar bed had always made a distinct hit with the masons and it was decided to continue this in

spite of the change to a three-core block. With the co-operation of the Consolidated Concrete Machinery Company, a unit was designed with three rectangular cores instead of the usual oval cores. The cores were so tapered at the top that the old mortar bed was retained. This gave a block with approximately 50 per cent air space and at the same time sacrificed none of the strength or utility of the unit. Quite a considerable saving was made in the amount of concrete going into each unit. The block is full 8 in. high, a requirement of the Milwaukee market, and an 8 by 10 by 16-in. unit weighs 54 lbs., while an 8 by 12 by 16 unit weighs but 59 lbs. The advantages of such units can be readily seen in a stiff competitive market. A picture of a 10-in. unit is shown. From the photograph it seems to be an unusually heavy and bulky unit, but a study of the end view will reveal the design that gives this appearance but at the same time reduces the weight.

(Continued on Page 41)



At the left is the automatic water meter and at the right the scales used in checking the weights of aggregate



The mixer floor, located directly above the machine. A 9 ft. and a 14 ft. mixer do the mixing for all block. The water meters may be seen above each mixer

EDITORIAL

Proportioning by Trial

IT is a definitely demonstrated fact that, given materials that are clean and structurally sound, the strength of the concrete depends entirely upon the quantity of mixing water used per bag of cement. This is the water-cement ratio law in a nutshell. It is not a difficult and involved principle. No technical training is necessary to understand it or to use it.

The cement and water "paste" made by mixing a definite amount of cement with a definite amount of water may be regarded as a glue which binds the aggregates together. This glue is strongest when the right amount of water is used. When more water is added the glue is diluted and it loses some of its strength.

Any reasonable amount of aggregate may be added to this glue without changing the strength so long as there is enough paste to coat all the particles and so long as the mixture does not get so stiff that it is difficult to place in the forms. The best way to determine how much aggregate to use is to mix up some glue in the required proportions of cement to water and then add aggregate (both fine and coarse) until a mixture of the workability is secured. Experience will show the best amounts to use.

No concreter need stand in awe of quality control. There is nothing difficult about it in its direct use.

Job Organization

IT is natural that when a contractor approaches a new job he arranges his plant layout much like the layout used on his previous jobs. He is used to working with that method and feels that a radically different arrangement will introduce difficulties. Besides, he is of the opinion that it is only on the large and very unusual job that some original and especially economical method for handling aggregates or concrete is possible.

Yet every job has its own peculiarities. There is some best way of arranging the plant and routing the materials. It need not be a large job to make an efficient layout show up in reduced costs. The small, ordinary job that is particularly well planned yields its full share of savings.

An illustration of a small, ordinary job that was carefully planned from the standpoint of eliminating lost motion and cutting down labor costs is found in the lead article in this issue. The description of that job was published not because it was an unusual job

but because it was an ordinary job particularly well done.

Most of the jobs awarded are ordinary jobs. Only occasionally does the average contractor secure a job that presents such unusual features that strikingly new methods of handling the work can be developed. The bulk of construction is made up of the smaller and medium sized ordinary jobs.

Because this is true it is easiest to apply a more or less standardized plant layout to every job that comes along. Little effort is made to determine the best and most economical arrangement for that particular job. If each job is considered as a brand new problem in plant arrangement, it is possible for the contractor to effect small savings in labor and time and equipment which when summed up constitute a worth while reward for careful planning.

Advertising Concrete Products Nationally

TANGIBLE evidence of the activity of the National Concrete Products Association will be found in the announcement published on another page of this issue. The program formulated at the Detroit meeting is under way and national co-operative advertising has begun. With "Spec" Collins as chairman of the advertising committee, products manufacturers may be assured of the proper handling of this important branch of the association's activities.

In order to carry on the work of the association so as to secure the best possible results, the co-operation of every progressive concrete products manufacturer is needed. All manufacturers will benefit equally from this advertising program and those who do not actively support it are definitely shirking their responsibilities.

Here is an opportunity for concrete products manufacturers to demonstrate that they *can* work together for the common good of the entire industry. There is a real need for an advertising program of this kind to overcome the prejudices that builders and home owners may still have against concrete block. Competitive material interests are aggressively pushing their products and unless the concrete products industry keeps the merits of its products before the building industry with equal insistence the industry and every manufacturer in it will suffer.

You, as a concrete products manufacturer, will be given an opportunity to do your bit in this constructive program now actually under way.

P. G. RILEY
President

P. G. RILEY

GENERAL CONTRACTOR

T. G. McGOVERN
General Supt.

~~701 Temple Street Downtown N. W.~~

Los Angeles

Dear Mac:

I notice you quite often mention the name of a friend of yours. "You were out on a party with Jack Wilson"—"You went fishing with Jack Wilson"—"Jack Wilson and wife had you out to dinner." That's fine, Mac, for friends in business help a lot. But sometimes, old son, they hinder too.

We hear a great deal about "It," this personality thing, which seems to us to be about the biggest item in every vocation and it is not at all a new thing either, Mac, but this "It" thing should be watched, I think, more now than when I was running that business, which was then the more or less one-horse business of P. G. Riley, because this "It" thing is getting to be sort of a perfected and thoughtfully applied science used sometimes with malice aforethought.

Did "It" enter into my relations with my old friend, John Brundage? Sure thing, but wise old John would say, "P. G., forget me in this transaction; you take the time to check up these other concrete mixers and watch them in operation. Try mine out alongside of 'em. Let my mixer sell you if it can, because if you buy friendship instead of a mixer, there is a chance that friendship will eventually be kicked out"—and believe me, I followed his advice.

Now this "It" thing, under the disguise of friendship, may turn out to be something that bites you, without you being able to locate the biter until you have had to scratch the bites so long that they get good and sore and then you wish you had stopped the biter before he had bitten you—or it can turn out to be a fine preventive for bites of every kind.

Kid yourself as much as you want to about not letting "It" influence a buy, but you know this "It" thing is the biggest thing in every transaction. You need a machine. Right away you think of a half a dozen concerns selling machines such as you need. Each representative who calls admits he has the best machine—proves it, in fact, by testimonial letters and records from users. Then we are apt to think, "Oh, well, I can't go wrong with any of these machines," so you buy from the fellow who dazes you with his personality, instead of comparing machines in actual operation.

It is natural that men who are responsible for all written and oral selling talk are prejudiced and that their judgment should not be relied upon, and sometimes personality or "It" has too great an influence over our own judgment, unless we let the machine itself sell us on the job.

Now, Mac, this fellow Jack Wilson may be a profitable card to hold, but be careful that he isn't a wild deuce you don't control. Hey, now, boy, don't get me wrong. I sure believe in friends, but make this Jack Wilson prove his friendship; in other words, don't let this "It" thing be a large piece of sticky flypaper.

As ever,

P. G.

P. G. Riley is a former contractor spending his days of retirement under California's sunny skies. Mentally, however, he is almost as much "in the game" as he ever was.

Perhaps his greatest pleasure is in keeping touch with his superintendent, Tom McGovern and, off and on, his secretary, Anna Ryan. His being away from the scene of activity has given P. G. some new viewpoints and he manages, in his letters, to convey to the young folks some of the ideas in the back of his head. One of the bits

of advice he has already given "Mac" concerned the wisdom of investigating operating performance when buying equipment. At another time he told Mac of the "catch" in the seemingly attractive trade-in offer. There's a lesson, too, he said recently, in not letting old, inefficient equipment eat up the profits.

In another recent letter "P. G." passed on to Mac a little incident he had heard about, to the effect that horse trading tactics in equipment buying are not the best way of doing business.

Centrally-Mixed Concrete for Buildings

An Analysis of the Place of the Central Mixing Plant in Modern Concrete Construction, in Which the Arguments in Favor of the Use of Centrally Mixed Concrete Are Presented

By HARRY F. THOMSON

M. Am. Soc. C. E.

ONE of the important recent developments in methods of concrete construction is the introduction of central-mixing plants in cities of 50,000 population and more. The construction work served by such plants has varied in different localities, but, in general, it has ranged from simple structures, such as pavements and small foundations, to large foundations and concrete buildings of all types, and to municipal work, such as paving and sewer structures. Some of the factors contributing to the growth of this practice, as well as some of its limitations in building, are noted herein.

Improvement in Quality

Probably the feature of central-mixing which is most fundamental is the opportunity for improving the uniformity and quality of the concrete. The general recognition of such improvement will ultimately result in changing present bases of design, either by using a mix that is leaner, but has more uniform strength, or by using a smaller quantity of the mix now specified, because an assured higher unit strength permits reduction in area to obtain an equal strength. Either development means a decrease in the total cost, with the attendant opportunity of extending the use of concrete.

During the development stage or until the more general recognition of the improvement in quality, several other features will justify a growing use of this practice:

(1) Convenience to the contractor, both through ordering as needed instead of planning stocks in advance, and through permitting concentration of attention on the placing and other details instead of on the mixing.

(2) Simplifying the contractors' organization by eliminating the mixing crew, and also by ordering a single item which is used as fast as received, instead of storing three or four separate items.

(3) Dispatching; the modern large central-mixing plant has a truck "dispatcher" and route supervisor, thus permitting proper dispatching and desired deliveries at the construction site.

(4) Speeding up of work (except when the construction work is adjacent to a railroad siding), because concrete can be supplied faster than the contractor can mix it, owing to the wider range and increased flexibility of delivery, taking into consideration the temperature, distance and time.

(5) Minimizing interference from weather; for instance, the central plant usually can furnish heated concrete in winter.

(6) Economy in ground space by eliminating the stor-

age piles; this is especially important in congested districts where interference with traffic, through utilizing street areas, is serious.

(7) Saving in total cost, in many instances, dependent on individual circumstances.

Refinements in Control

Among the possible refinements in control which contribute toward securing stronger and more uniform concrete, may be mentioned:

Water Control.—A permanently installed central plant



The plant shown above is that of the Ready Mixed Concrete Corporation at Chicago, Ill. The structure is now enclosed with galvanized sheeting similar to the cement warehouse alongside the plant

can install equipment to insure positive, accurate, and automatic control of the water content of the concrete. Such control of course must allow for moisture of the aggregates, which is entirely feasible in a central plant. The influence of the human element can be all but removed; the use of a pressure tank with automatic measurement resulting from a dial, or other mechanical setting, is much more accurate than an open tank with visual gauge which must be watched by the operator.

Grading of Aggregates.—A central-mix operation is in position to obtain the co-operation of aggregate producers toward furnishing well-graded aggregates instead of material preponderant in some sizes and deficient in others, which are sometimes furnished when the inspection on the job is not very rigid, or the requirements are not definitely specified. The importance of the grading, as affecting strength, density, and workability of the concrete, is frequently overlooked.

The aggregates in many districts do not make the best concrete when used in the old, accepted proportion of 2 parts coarse to 1 part fine. Local regulations, which recognize the old 2 to 1 idea only, should be changed.

Measurement of Aggregates.—A central plant is also able to adopt refinements in the measuring of aggregates which would be possible on only the largest of jobs. Almost without exception they weigh sand, and many are also weighing the coarse aggregate in lieu of volume batching. The best practice apparently provides a separate scale for each aggregate. In providing weighing equipment, each scale should have a dial or other direct-



The John P. Callaghan Ready Mixed Concrete plant at Harrison, N. J., is of the gravity type and built according to the Johnson Octo-bin design. The overhead bins are loaded by two bucket elevators. The plant is capable of handling over 600 cu. yds. of concrete in a 10-hr. day

reading attachment for indicating the net weight in the hopper, instead of depending on the balancing of the beam; faster and more accurate weighing will be obtained by such means.

Mixing.—Mixing with large batches is more accurate than with small. Also, the central plant can install meters to insure a certain minimum mixing time, commonly as high as 2 min., instead of the haphazard $\frac{1}{2}$ min. to 1 min. which is usual with portable job-mixing. Such timing limits the output from a given mixer, but contributes to a stronger, more uniform concrete.

Specialization of the Personnel.—In a permanent central-mix operation skilled workmen contribute in many small ways toward improvement. This specialization is reflected in the refinements in the mixing of concrete, which has now developed to the status of a manufactured product. Formerly it was regarded as a more or less irregular mixture of cement, aggregates, and water; this was owing to the irregular inspection at the mixer and to

the uneducated and irregular personnel engaged in the mixing.

Central-Mixing for Buildings

The two questions which are most frequently raised in discussing the practicability of applying in building construction the improvement in quality offered by central mixing, are: (1) The influence of the time of haul on the strength of the concrete; and (2) the method of transporting the concrete from mixer to job.

Strength vs. Time of Trucking.—A widespread misconception is held by many experienced contractors, that the strength of concrete is impaired if not placed in the forms within a comparatively short time, not exceeding 30 min., after being mixed. This idea is reflected in the building codes of many cities and specifications of many architects and engineers. The fact is frequently overlooked that the initial set of modern portland cement does not occur under normal temperature for from 2 to 3 hours after mixing. It has also been shown by repeated observations that the re-handling of the concrete during this interval does not reduce, but may decidedly increase, the strength. The one factor which is sacrificed during the interval is some part of the original workability—the degree depending on the conditions.

The tests of concrete after trucking, by the United States Bureau of Public Roads,¹ indicate increasing strength of concrete after 2 hours and 10 min. elapsed time. For the additional hour, or up to 3 hours and 10 min., the concrete showed no great reduction in strength, but might not have satisfactory workability. Similar tests by Columbia University Testing Laboratories² indicate practically the same results.

Thus, the conclusion of those who have investigated this feature has been that the strength is not reduced, but under most circumstances is increased due to better hydration, by a considerable interval, certainly up to 1 hour or more, between mixing and placing. It is also recognized that there is a decrease in workability during such interval, and that the decrease is less if the concrete is agitated than if it remains quiet in the body during the haul. With pneumatic-tired equipment, as now used by most commercial central-mixing plants, it is possible to deliver over an area of roughly 10 or 12 miles radius during a 1-hour truck haul. Usually, the length of haul will be limited by conditions of relative costs, rather than by the physical condition of the concrete.

Method of Delivering Concrete.—The second query, that of the method of transporting the concrete from mixer to job, is probably receiving more attention from those interested in central-mixing operations than any other single feature. The ultimate and ideal type of body has not yet been produced. The truck body adopted by several prominent commercial plants is the round-bottom or "bath-tub" type of rear dump, with high angle of elevation. The experience in St. Louis, Mo., has been that a 1:2:4 mix with 6 to 6½ gal. of water per sack can be hauled 3 miles in this body with only minor delay due to a part of the load packing and not discharging itself.

At the present state of development, mixes with higher water contents appear to require some method of agitation during haul; and in several cities construction requiring fairly wet concrete is being served by "mixing trucks" which receive dry batches at the proportioning plant and do the mixing either just before or just after arrival at the job. If central-mixed concrete is agitated during haul by blades or a special rib, there is left next to the shell of the body a layer of untouched material

¹ "Public Roads," December, 1921.

² Rept. No. 1778, December 16, 1927.

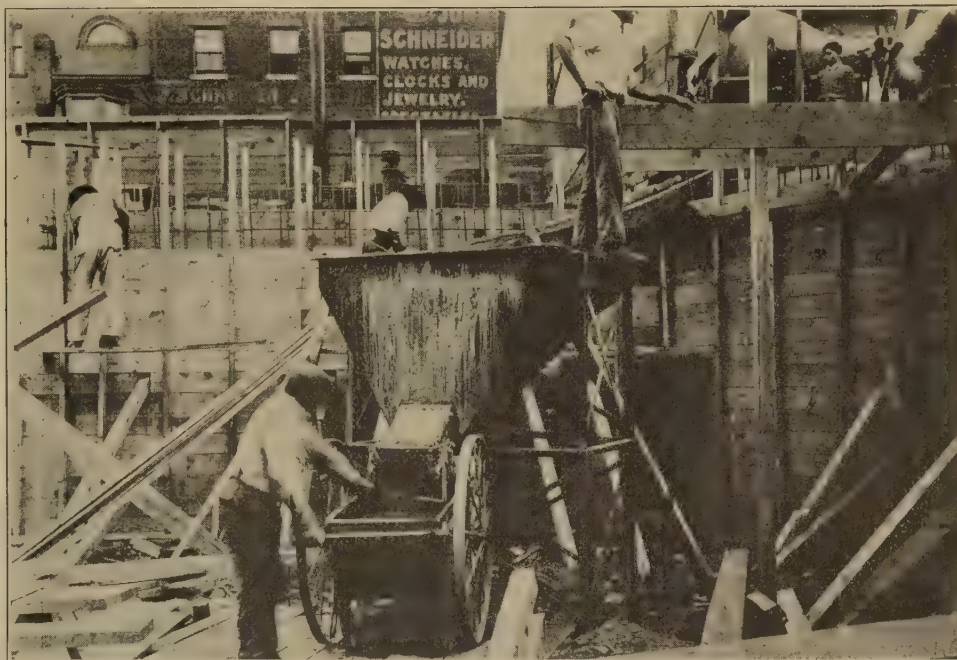
which must be scraped out by hand, so that little gain is accomplished over the open, round-bottom body. A body which is substantially a revolving cylinder in trunnions has also been used, but this involves mechanical complications and delays in both loading and dumping. Other efforts have turned to bottom-dump hoppers, and to bodies in which the sides move either vertically or horizontally with reference to the flat bottom of the body. The application of such types has usually been in special work rather than in general commercial service.

Apparently, the best results have been obtained by dumping the truck load into a hopper, from which the concrete can be drawn as desired into buckets, buggies,

tral mix is endeavoring to furnish a quality concrete, and also the added water frequently washes the mortar from the gravel and thus induces honeycombing and weak spots; and, second, the crew should make a point of permitting trucks to dump promptly on arrival, as delays are costly to the vendor through loss of working time of the equipment, and are also costly to the contractor because of the loss of workability when the concrete is held quiet in the truck for a considerable time.

There is another way in which close co-operation between contractor and vendor will be mutually helpful. When a contractor first uses central-mixed material, he should not condemn the operation if the first load or two

Showing how the concrete is handled after being delivered to the job from the central mixing plant by truck



hoist skip, elevator, or other container for rehandling. By use of a hopper there is retained any small quantity of water which may have come to the surface during trucking, and there is a natural remixing as the load passes into and out of the hopper. Concrete containing 6 to 6½ gal. of water per sack will not flow in long chutes, but is suitable for distribution by buggies and will place readily around reinforcing. Cylinders from a recent delivery of concrete of this consistency to a building job in St. Louis showed an average strength of 2,000 lb. in 7 days.

Precautions in Using

The successful use of central-mixed concrete by a building contractor requires good co-operation between the contractor and the concrete vendor. In this case "concrete is not concrete" as usually known by the contractor; it is mixed on call at a distance from the job, is placed by a different organization than the one that mixes it, and, above all, it is a perishable commodity. If, however, both factors will discuss in advance the requirements of the job, ideas can be exchanged, and the mix and handling arrangements can be set up to serve the job with mutual satisfaction.

Two "don'ts" should be observed: First, the placing crew should not be permitted to add water indiscriminately, as this destroys the control through with the cen-

does not work just as smoothly as he had anticipated, because the delivery of concrete should be recognized as a new development in the construction field, and there are numerous instances of the rate of placing by a given crew being almost doubled as the men became more experienced with the characteristics of the service.

Viewed in a broad way, the central mixing of concrete offers an opportunity of obtaining in building construction the manifest improvements in the quality of the concrete which result from more accurate control of the mixing operation than is usually practiced on the job.

"Cutting Production Costs in Products Plants"

Possible confusion occurring to those reading the article "Cutting Production Costs in Products Plants," by Lyle Ballantyne, on Pages 19 to 22 of the June issue, was probably due to the transposition of the second and third pages of the article.

The matter appearing on Page 20 should have followed that on Page 21. In this way the article reads correctly.

What Is Rail Steel?

Why It Is Called "Rail Steel"—How It Is Prepared— Specification Requirements

By H. P. BIGLER

OF the four standard grades of concrete reinforcing bars now in common use one of them, known as rail steel, has a history of interest to architects and engineers because of the educational campaign responsible for its present use.

When reinforced concrete was in its early days of development, rail steel mills were engaged in producing light manufacturing shapes which were popular for industrial fabrication. These mills, at that early period, produced some of the first few tons of bars used for concrete reinforcement and have since developed and improved the manufacture of this product until today, the industry is of importance among those allied to reinforced concrete construction.

In 1911, rail steel mills combined their individual studies, researches and other development efforts by organizing the Rail Steel Bar Association which has, since then, acted as the clearing house for industrial research as well as the official representative of the industry in all activities concerned with the development of reinforced concrete.

These associated mills, located in nearly every large industrial section of the United States and Canada and convenient to our greatest construction activities, are required strictly to meet, in their products and process, the standards of their own association as well as the specifications of the American Society for Testing Materials.

Well Established Reinforcement Standards

Uniform standards for design and construction of reinforced concrete have been developed by our national technical societies and by the sectional building code conferences to be used as models for building regulations of cities throughout the nation. Probably the most widely copied is the standard building code of the American Concrete Institute. The reinforcement specification in this standard reads:

Metal Reinforcement:

Metal reinforcement shall conform to the requirements of the "Standard Specifications for Billet-Steel Concrete Reinforcement Bars" of Intermediate Grade (Serial Designation: A15-14), or for "Rail-Steel Concrete Reinforcement Bars" (Serial Designation: A16-14) of the American Society for Testing Materials.

This illustrates the general tendency of reinforced concrete design toward the recognition of higher strength in reinforcement by the designation of only two of the four available grades, rail steel and intermediate. This recognition is also illustrated in the unit stress of 20,000 pounds allowed for these two grades.

Engineers and architects are generally acquainted with what has been called above the "four standard grades" of reinforcing bars. They are (1) rail steel (2) structural grade (3) intermediate and (4) hard grade (billet) all varying in some degree in the physical properties they possess. In one case, however, there is sometimes a slight confusion in the minds of those who are not closely acquainted with reinforcement. Rail steel is a standard

grade and is not to be confused with grades termed "re-rolled" that have no standards.

Similar to the hot rolling process followed generally in the production of all steel bars that is employed by rail steel mills, the process consists in reducing heated slit-rail billets to bars of required size.

Standard tee-section railroad rails, the sources of the technical name by which rail steel reinforcing bars are known, come to the mills as selected raw material. Furnished under strict requirements governing size, length, uniformity and condition (no frog, switch, guard, curve, bend or twist or split-head rails are permitted), these rails are again inspected after being received at the mill. Only straight lengths and normally perfect sections are retained for the very evident reason that an imperfect rail in rolling will form what is known as a "cobble" and cause serious damage to mill equipment and subsequently delay in operation. After inspection rails are sorted according to nominal weight and stored until needed for rolling.

When needed for rolling, rails are selected from the inspected stock in sizes required to produce bars of the

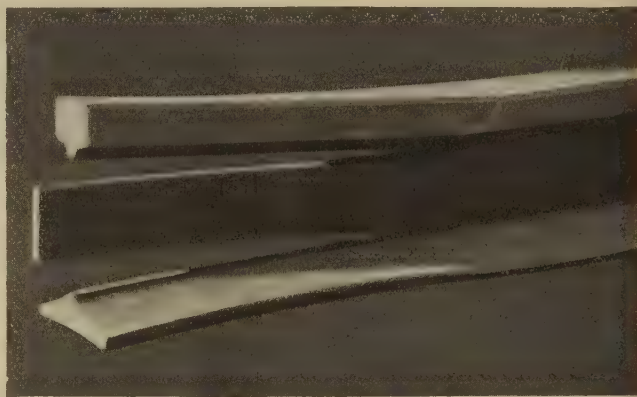


Figure 1

diameters and lengths desired. They are charged into a furnace of the continuous type where each rail is slowly and uniformly subjected to what is known as a "soaking heat" and raised to the same temperature throughout its mass. The heating of these rails, the raw material, is an important factor in rail steel production and is accurately controlled by means of pyrometer observations. When removed from the furnace for rolling, the rail temperature is approximately 2100 degrees Fahrenheit.

Since the rail as a raw material comes as combination of three parts—the head, web and flange—these parts must be separated to form what is known in the industry as slit-rail billets. The heated rail therefore is immediately conveyed from the furnace to a set of rolls called "slitters" where the head, web and flange are divided to form three separate billets.

Figure 1 shows a partly slit rail, illustrating the manner in which this separation is accomplished.

Through separate sets of rolls, the three slit-rail billets are gradually reduced by a series of successive passes, each reduction refining the grain and improving the physical quality of the steel. After the last or finishing pass, the bars are conveyed to hot-beds where by group annealing and by slow uniform cooling the quality of toughness is improved. In each step inspections are made for size and surface defects and at regular intervals check samples are taken for physical tests by the mill laboratory. Figure 2 is a process diagram illustrating the separation of the three parts of the rail and the reduction of each of these parts to finished products. The same rail

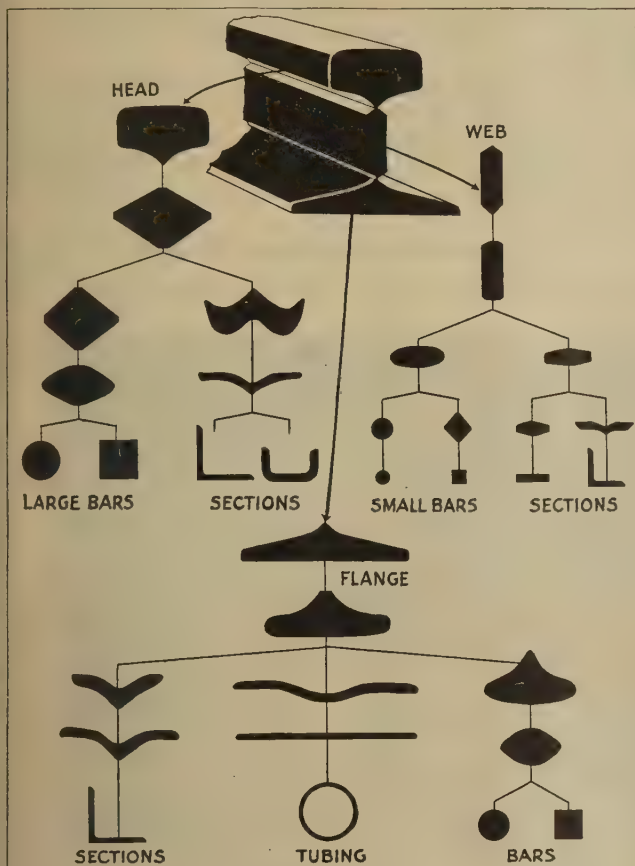


Figure 2

will produce at one time three distinctly separate products.

Fabrication

When the bars have cooled and are properly annealed, they are removed from the hot-beds, cut to proper lengths and conveyed to the fabricating department of the mill. Bending is an operation in which care must be used regardless of the toughness of the steel. The fabricating equipment should be properly designed with pins of correct bend diameters and operated at speeds that insure proper "flow" of the metal in the bar. Bars should always be shop bent when this is practicable. In nearly all cases of breakage the trouble lies in mistreatment of the steel by poorly controlled field bending.

Rail Steel Properties

The qualities of rail steel bars are inherited largely from the raw material but improved by the rolling process. It is a well known principle of metallurgy that the "working" of steel by rolling reduction definitely refines its grain structure and physical properties. Figure 3 contains two photomicrographs magnified 100 diameters

showing the grain structure on (a) a rail before rolling and (b) a rail steel bar, indicating clearly the effect on the grain structure of additional rolling. A rail steel bar not only receives the original rolling of the rail but, in addition, that necessary to reduce the rail to reinforcing

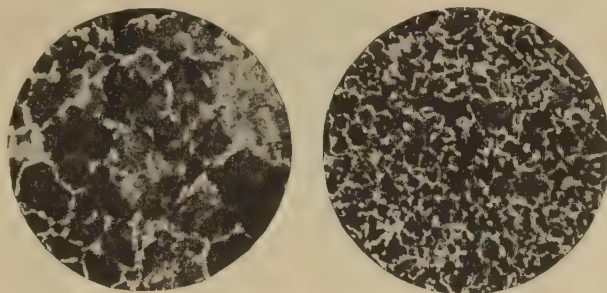


Figure 3. Photomicrograph (100 diameters) showing the grain structure of (a) rail before rolling and (b) a rail steel bar. The effect of rolling is clearly denoted.

bars. Accurate methods of heating and cooling also have a definite effect on the final properties of bars and are important factors in the control that is uniform throughout the industry.

Modern Construction and Rail Steel

It has been said by some that rail steel has been responsible for a considerable share in the development of reinforced concrete as a modern method of construction. Certainly the industry has lent every effort, not only to improving its product, but to the development of the field for its use. The success of these efforts is evidenced by the many outstanding structures of varied types of today in which rail steel has been used.

Engineering Takes Part in World Congress at Tokio

A review of outstanding industrial and engineering developments in the United States during recent years is contained in the 80 scientific papers prepared by American engineers for presentation at the World Engineering Congress convening at Tokio, Japan, on October 30th next.

Among the contributors are: John I. Stevens, former chief engineer of the Panama Canal, and noted railway expert; Ralph Modjeski, builder of the Delaware River Bridge at Philadelphia and other bridges; C. E. Grunsky, of San Francisco, civil engineer and consultant on municipal engineering; Ole Singstead, chief engineer, N. Y. State Bridge and Tunnel Commission, and builder of the Holland vehicular tunnel under the Hudson River; Allen Hazen, of New York, hydraulic engineer and expert on dams, and Thaddeus Merriman, chief engineer, New York City Board of Water Supply.

L. P. Alford, consulting editor, McGraw-Hill Publishing Company, has prepared a paper on the subject of scientific industrial management; H. P. Moore, research professor of engineering materials, University of Illinois, will contribute a paper on "The Development of the Science of Structural Materials."

Trends in standardized quality production will be treated by John H. Van Deventer, of New York, president of the Engineering Magazine Company; Elwood Mead of Berkeley, Calif., U. S. Commissioner of Reclamation, will present a review of irrigation growth in the United States, and H. de Berkeley Parsons, consulting engineer of New York, will discuss masonry dams.

The technical sessions of the World Engineering Congress will be held during the first week of the meeting, beginning November 1, 1929.

A Modern Concrete Pipe Plant

Atlantic Cement Products, Inc. Operates Pipe Plant Designed for Economical Operation—Aggregate Handling Equipment—How the Pipe Are Made—Plant Layout

By H. R. SWARTLEY, JR.

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THE pipe plant of Atlantic Cement Products, Inc., at Hicksville, Long Island, provides an interesting illustration of effective plant design and production methods in the manufacture of concrete pipe.

The Market

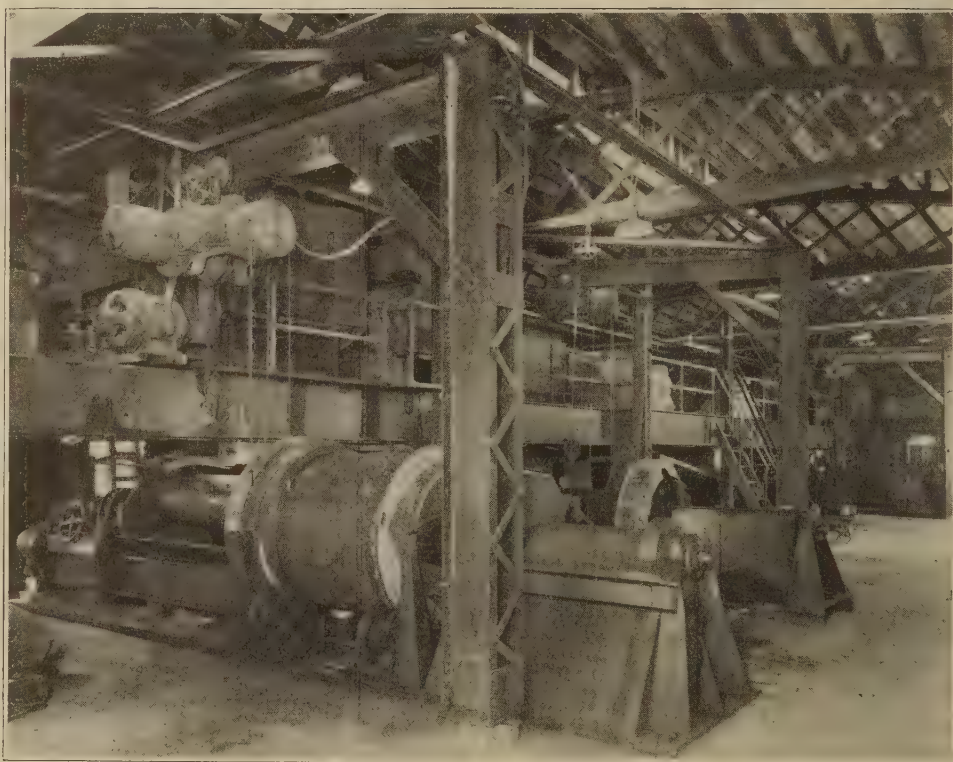
Long Island contains a population of about 3,500,000 in its area of 1373 square miles and is growing very rapidly. It is traversed by splendidly paved roads and contains hundreds of thriving communities. Because of their

in securing a uniform product and in minimizing labor expense. Labor-saving devices have been installed throughout.

This is particularly true of the aggregate-handling equipment. The aggregates—sand, gravel and grit—are dumped from trucks into three receiving hoppers and elevated to their designated overhead bunkers. The materials then flow by gravity to the mixers, and to the pipe-making machines.

The correct amounts of aggregate are supplied through

The two pipe machines. There is a mixer located on the mezzanine floor directly over each machine



rapid growth, the towns and villages have been unable to keep pace with sewer and water supply requirements.

Fortunately, an inexhaustible supply of the very finest sand and gravel is found on the Island, so that the question of concrete aggregates is a simple one. The Hicksville plant is located on a tract of about 36 acres, all of which is underlaid with a sand and gravel bed, 40 or 50 ft. thick.

Prior to the decision on the design of the plant and the process to be employed in pipe manufacture, the officials of this company spent nearly two years investigating all the established methods in use throughout the world. They desired first, to manufacture pipe of high quality, and second, to reduce the personal element insofar as possible

measuring boxes, the gates of which are remotely controlled by the mixer men. There are separate storage bins for different sizes of aggregates, inasmuch as the larger pipes are made with larger aggregate than the smaller pipes. There is a mixer for each pipe-making machine, the mixers being located on a mezzanine floor, directly over their respective pipe machines and discharging into hoppers through the mezzanine floor. Davis & Averill, Inc., of Newark, N. J., designed and installed the aggregate handling equipment.

The Moir Buchanan centrifugal process, which takes its name from its Scotch inventors, is used in the manufacture of the pipe. The Atlantic Cement Products, Inc., uses this process under license from the Asphalto-Concrete



The above illustrations show the Moir-Buchanan principle of operation. "A" is a one-piece metal mold spun by a lathe, "B" is a tubular bucket, rotated by an air motor, and "C" is a hardened tool steel trowelling blade. A full explanation of the operation is given in the story

Corp. of New York City.

The concrete is mixed in a 1:3½ or 1:4 proportion, with enough water added to make it easily workable, although the water content is not measured. This may sound unscientific in view of the theories which have been developed on water-cement ratio for maximum strength of concrete. However, the following explanation of the process will show that the proper water content is obtained in the finished pipe, regardless of the amount used in the original mix.

How the Pipe Are Made

From a hopper directly underneath the mixer, the concrete is dumped into a bucket or trough, which is the same length as the mold. The bucket is supported at one end by a carriage, which is run forward to insert the bucket into the mold. The bucket is rotated to the dumping position, and the concrete is uniformly discharged into the mold, which is turning at sufficient speed to spread the concrete charge inside the mold. It takes two bucket-fuls to form a pipe shell. When the second charge is being dumped, the mold is speeded up so as to compact the mass by centrifugal force. However, the speed is held below that at which there is any tendency for the heavier aggregates to be thrown to the outside.

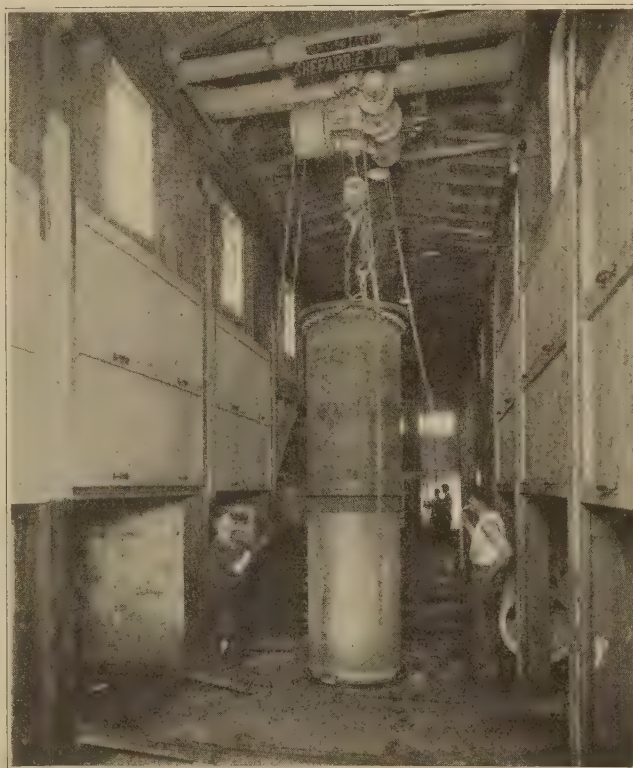
The axis of the bucket is slightly below and to one side of the axis of the spinning mold. On one side of the bucket there is attached a heavy, hardened steel blade of the same length as the bucket. Due to the eccentric mounting of the bucket, this blade does not come in contact with the concrete shell when the bucket is turned to the dumping position, but due to this same eccentricity, the blade does make contact with the concrete when the bucket is rotated in the opposite direction.

An amount of concrete in excess of that required to form the shell is deliberately introduced to be sure that the finished pipe wall will be of desired thickness. When it engages with the concrete, the blade trims off the excess material which is collected by the bucket. The operator, by turning a hand-wheel connected through a worm gear, can apply an increasing pressure to the blade and very uniformly compact the concrete with a trowelling action of the blade. It squeezes out all excess water, leaving the correct amount for maximum strength of concrete. The finished interior surface is perfectly straight and smooth and free from laitance.

The sections broken from the finished pipe wall show a uniform structure of concrete, with as much coarse aggre-

gate next to the interior surface as there is at the outside. A very thin film of fine cement is brought to the interior surface by the trowel and its smoothness gives a pipe with maximum carrying capacity.

The machines are practically automatic. The carriage which supports the bucket is traversed by an air cylinder

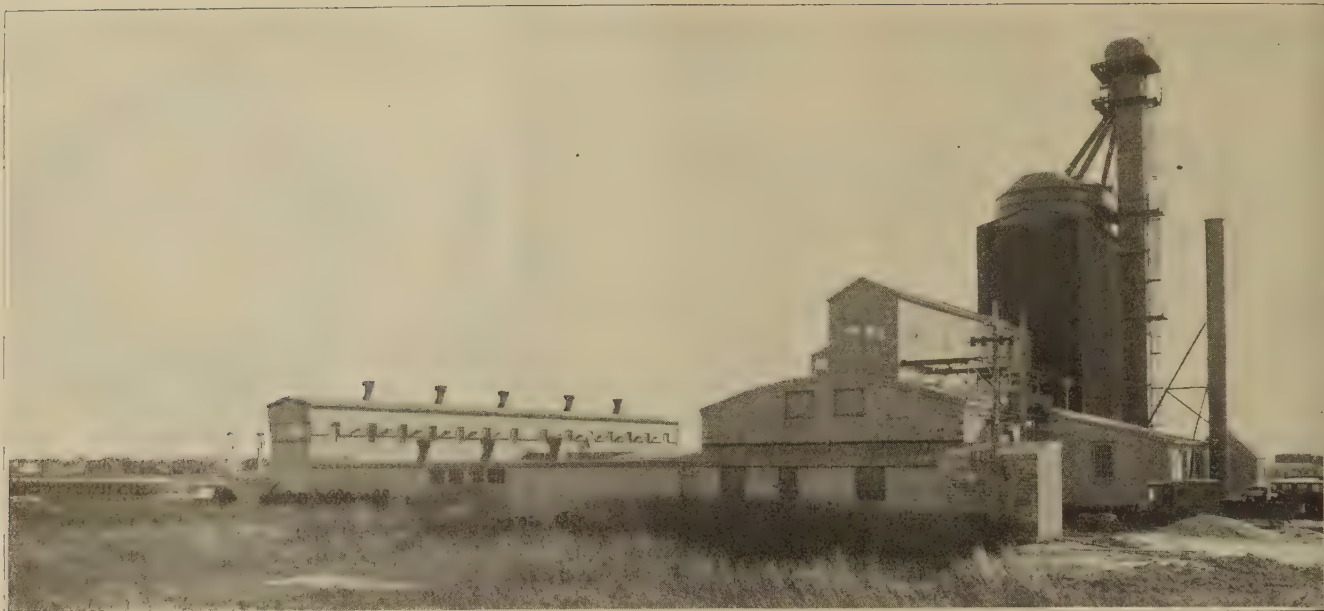


Removing the mold from the pipe after they are taken from the steam curing rooms

with simple valve control. The bucket is dumped and reversed to the trowelling position by another air motor. The desired mold speed is readily obtained by remote control of the driving motor.

The empty molds are placed on the trunnion rollers by an overhead electric crane and then removed with the finished pipe inside and deposited at the mouth of the steam-curing kilns. The operators are relieved of any heavy manual labor.

The molds themselves are made of cast iron in the

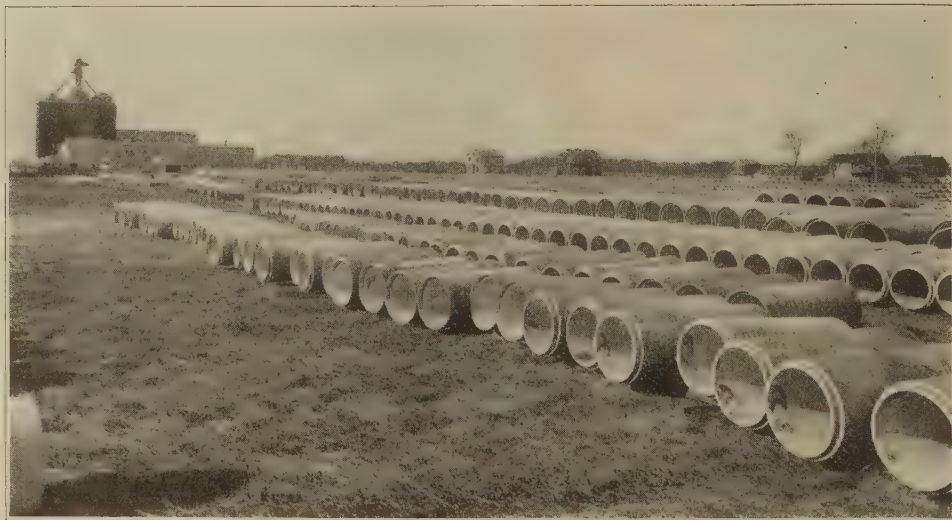


A general view of the Hicksville plant

smaller sizes and boiler-plate steel in the larger sizes. They are in one piece, and, in the case of the steel molds, have a single longitudinal weld. They are heavy enough to withstand any abuse to which they may be subjected and prevent distortion. The smaller pipe sizes are made with standard bell and spigot joint, while the larger sizes have a so-called tongue and groove joint which might better be termed a "cone" joint. The pipe ends are accurate in dimensions because they are formed by one-piece, end-forming rings securely attached to the molds. The pipe machines and molds were manufactured by Manning, Maxwell & Moore, Inc., of New York City.

reinforcement is slipped into the waxed mold. The cage is made from high strength steel wire as a continuous spiral on a mandril, with sufficient longitudinal rods and welded junctions to maintain a specified pitch and to provide necessary strength of the finished pipe when acting as a beam.

Upon leaving the pipe-making machines, the molds and green concrete shells are rolled into steam-curing kilns, into which saturated live steam is blown in quantities sufficient to maintain a temperature of about 90 deg. F. for 8 or 12 hours. Just before opening up the steam kilns, the temperature is raised to a point sufficient to melt the



*The outside storage yard.
The plant is in the back-
ground*

Preparing the Molds

Before the molds are placed in the pipe-making machines, they are given an interior coating of paraffin. A measured quantity of melted wax is poured into the molds, which are then rolled over a few times until the wax hardens. The purpose of this wax coating is given later on.

The steel reinforcement cage for such pipe as requires

wax with which the molds were coated and free the pipes from the molds. The molds in the kilns are slightly inclined so that as the wax melts and runs out it is caught in a collecting trough which leads to a sump at the end. There is practically no loss of wax and it is used over again after being sufficiently heated in steam kettles.

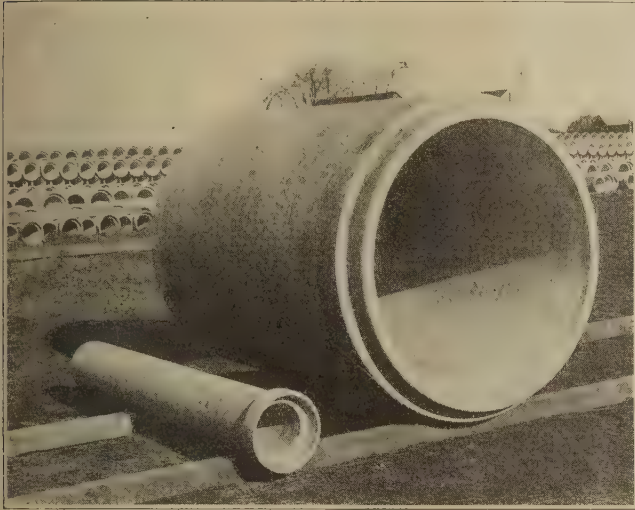
When the outside temperature is 40 deg. F. or higher, the pipes are taken directly to the storage yard. During

periods of lower outside temperature, the pipes are taken to a secondary kiln where they are maintained at a temperature of about 70 deg. for several hours and then taken to storage.

A pipe testing machine is installed in a separate building by means of which they may be loaded to destruction and the strength accurately measured. It is of the standard three-bearing type.

The owners of this plant have shown confidence in the future of concrete pipe requirements by the substantial nature of the equipment installed. The plant is maintained in an unusually clean condition, there is practically no spilling of slurry from the molds, nor of concrete around the machines.

One of the outstanding advantages of such a permanent plant is its ability to operate to capacity regardless of



Specimens of the largest and the smallest pipes produced at the Hicksville plant

outside weather conditions. Any desired rate of production up to the capacity of the plant may be maintained. Every step is under the eye of the superintendent, and the workmen carry on in comfortable, familiar surroundings.

Tests

A specimen of concrete broken from the wall of a pipe 4 in. thick—48 in. internal diameter—and tested by Columbia University, showed an absorption of 2.64 per cent, the mixture being 1 to 4.37. This same specimen weighed 166.5 lbs. per cu. ft. Such density of concrete is rarely obtained and is, of course, a direct measure of its durability.

The plant at Hicksville started operations in the spring of 1928. Almost all of its output is delivered by truck to the point of installation.

The Hicksville pipe is made in 6-ft. lengths in standard sizes from 8 in. to 48 in. inclusive. When first offered to the contractors who install it, they objected to the long lengths, having been familiar with 3-ft. pipe lengths. After a little experience in laying the pipe, these same contractors have become advocates of long lengths, because of the decrease in the number of joints and the lower laying cost.

New Tennessee Engineer

James E. Dunn has been appointed district engineer of the Portland Cement Association at Nashville, Tennessee, effective May 15th. His territory comprises the state of Tennessee.

Contractor Pours and Finishes Concrete in One Operation

A new method of placing concrete to achieve a perfectly smooth finish in one operation, that presents the appearance of perfect masonry finish for exteriors and an absolutely smooth finish for interiors, has recently been evolved and is now being successfully used at Los Angeles and Oakland, California.

The system, originated by the Scofield-Twaits Engineering and Construction Company is exceedingly simple and



The 3-story job on which concrete was poured and finished at the same time

saves the labor and time as well as the cost of refinishing the concrete surface.

An example of this new process is in the recently constructed factory building of the Continental Can Company at 54th Avenue and Russell Street, Oakland, California. This is a three-storied structure of reinforced concrete, designed by Francisco and Jacobus, architects. Eight thousand cubic yards of ready-mixed concrete were furnished by the Hutchinson Company of Oakland, operating on this job a fleet of eight truck mixers, pouring an average of four hundred cubic yards in eight hours.

Strips of molding were nailed to squares of pressed



A close-up view of the finish secured

wood. These squares being about 4 by 6 ft., were placed in the forms and the concrete poured in the usual manner. After two or three days, the forms were taken down and the pressed wood squares used on another part of the job. The advantages of pouring and securing a perfectly smooth finish in one operation without the added cost of finishing, are readily apparent.

The design called for a 1:2:4 mix with 3 per cent of diatomaceous earth. One of the illustrations shows a corner of the exterior finish. No refinishing was necessary.

How to Build

Solid Slab Reinforced Concrete Floors

Helpful Design and Construction Information for the
Builder of Floors for Residences or Small Buildings—
Form Details—Essential Requirements Include Approved
Design, Ordinary Skill in Form Building and Knowledge
of Good Concrete Construction

THERE are three popular types of reinforced concrete floors suitable for houses or small buildings—solid slab, tile and joist, and ribbed. The solid slab type is discussed in detail in this article, while subsequent articles giving information on the other two types will be published in the near future.

The solid slab floor, as its name implies, is a reinforced concrete slab of uniform thickness extending over the entire floor area. With the ordinary equipment used by concrete contractors or builders, this type is easy to build. In fact, once the proper design is determined, the work can be made as simple as average foundation construction. Builders also find that they can construct solid slab reinforced concrete floors at a comparatively small additional cost over ordinary wood joist construction.

Design Tables

Information for designing solid slab floors is given in Tables 1, 2 and 3. These tables give safe superimposed loads, or the weight that the floor will support in addition to its own weight, for different designs.

Table 1 gives the safe loadings for 4-in. slabs with spans of 8 to 10 ft.; 5-in. slabs with spans of 8 to 14 ft., and 6-in. slabs with spans of 8 to 16 ft. This design information is for use when the slab is simply supported or slightly restrained and continuous over two spans. Simple support means that the floor has bearing only on the outside foundation walls and that there are no beams

or basement partitions supporting it. A floor that is slightly restrained and continuous over two spans is one that is supported by the foundation and in addition by not more than one beam or basement partition.

Table 2 gives the safe loadings for slightly restrained slabs continuous over more than two spans. Such a slab is one that is supported by the foundation and by two or more beams or basement partition walls.

Table 3 gives the safe loadings for fully restrained slabs, although this condition is unusual in residence or small building construction. A fully restrained slab of approximately equal spans is one built to act integrally with foundation walls and beams or basement partition walls. For example, the floor may be cast monolithically with the foundation, as shown in the accompanying photograph, and be supported over a number of beams or basement partition walls spaced quite closely together.

Engineers using Tables 1, 2 or 3 should refer to the 1928 Building Regulations of the American Concrete Institute for conditions governing moment coefficients.

The following technical notes refer to Tables 1, 2 and 3, and contain information that will be helpful to the designer:

Loads: The safe superimposed loads in lbs. per sq. ft. given in Tables 1, 2 and 3 are based on the controlling safe loads as determined by bond, shear or bending. The dead weight of the structural slab only has been deducted from the total safe loads and the weights of surfacing,

SOLID SLABS

$$f_c = 800 \text{ lbs. per sq. in.}, f_s = 20,000 \text{ lbs. per sq. in.}, n = 15$$

Table 1.—Slabs simply supported or slightly restrained slabs continuous over two spans, controlling B.M. = $WL^2/8$

Slab Thickness, In.	Weight per Sq. Ft. Lbs.	Reinforcing Steel	Safe superimposed loads in lbs. per sq. ft. for the following spans				
			8	10	12	14	16
4	50	$\frac{1}{2}'' \phi c 8''$	74	44	—	—	—
5	62	$\frac{1}{2}'' \phi c 6''$	158	105	54	23	—
6	75	$\frac{1}{2}'' \phi c 5''$	254	185	108	59	28

Table 2.—Slightly restrained slabs continuous over more than two spans, controlling B.M. = $WL^2/10$

4	50	$\frac{1}{2}'' \phi c 8''$	115	68	—	—	—
5	62	$\frac{1}{2}'' \phi c 6''$	231	148	84	46	—
6	75	$\frac{1}{2}'' \phi c 5''$	—	254	154	93	54

Table 3.—Fully restrained slabs, controlling B.M. = $WL^2/12$

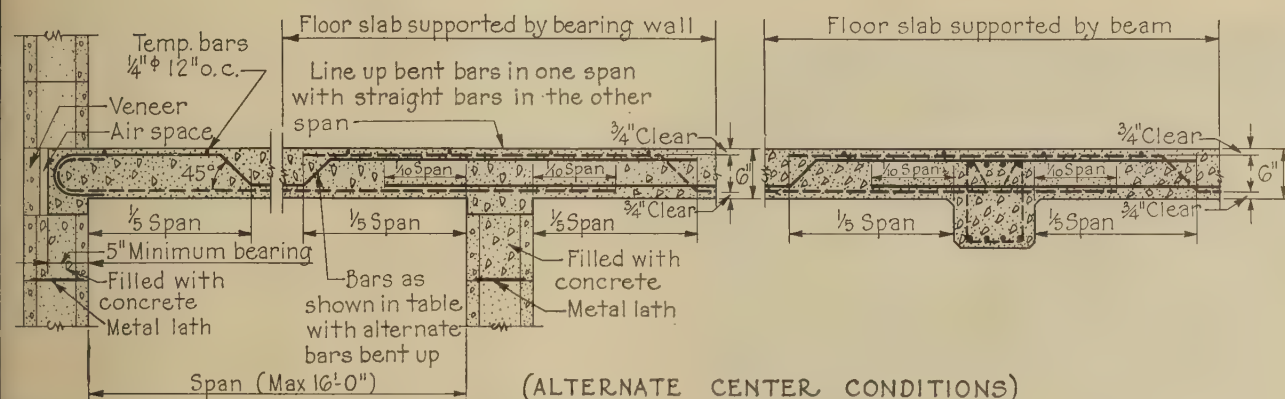
4	50	$\frac{1}{2}'' \phi c 8''$	170	91	46	—	—
5	62	$\frac{1}{2}'' \phi c 6''$	—	190	112	67	—
6	75	$\frac{1}{2}'' \phi c 5''$	—	—	199	125	79

Working Stresses: Working stresses are those recommended by the 1928 Building Regulations of the American

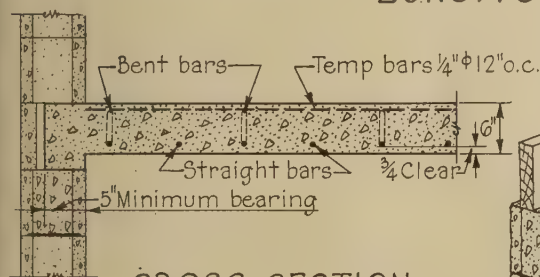


NOTES

1. Designed for concrete with a compressive strength of not less than 2000 lb. per sq. in. at 28 days (7 ½ gal. of water per sack of cement.)
2. Designed according to Building Regulations of the American Concrete Institute, 1928.
3. Loadings are those recommended for Residences by the Building Code Committee of the United States Department of Commerce.
4. Bearing partitions must be carried by walls or by beams and columns below.
5. Steel reinforcement must be accurately located and held in place. All intersections must be tied with No. 18 annealed wire
6. Wire fabric weighing not less than 25 lb. per 100 sq. ft. may be used instead of temperature bars.
7. Extra reinforcement is required around stairwells

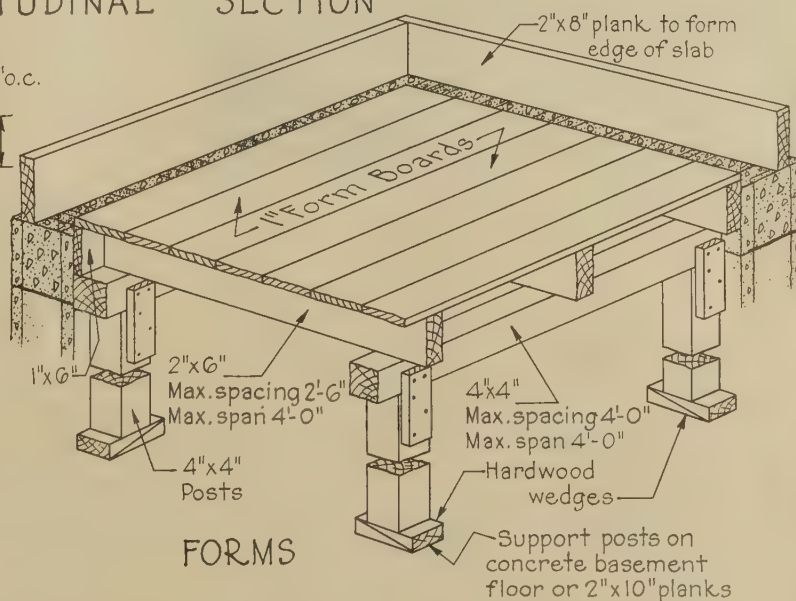


LONGITUDINAL SECTION



CROSS SECTION

REINFORCING BARS		
Span	Size	Spacing
10'-0" to 14'-0"	$\frac{5}{8}$ " ϕ	5"
14'-0" to 12'-0"	$\frac{1}{2}$ " ϕ	6"
12'-0" to 10'-0"	$\frac{1}{2}$ " ϕ	8"
10'-0" or less	$\frac{3}{8}$ " ϕ	7"



FORMS

SOLID SLAB CONCRETE RESIDENCE FLOOR

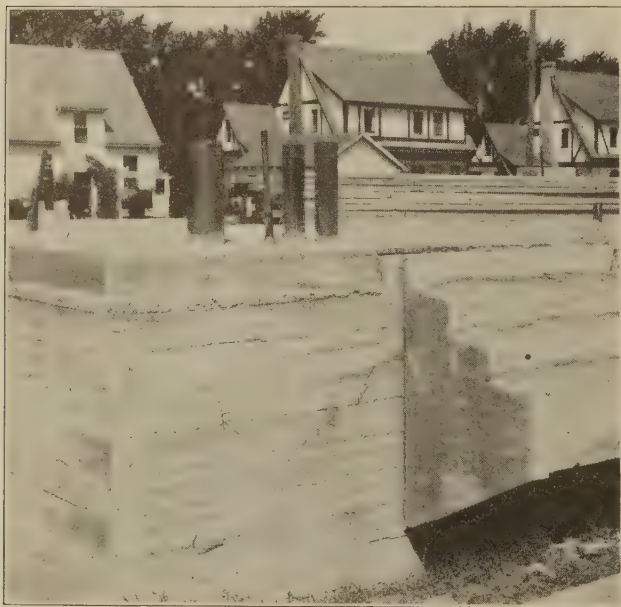
Concrete Institute for 2,000-lb. concrete— $7\frac{1}{2}$ gal. of water (total) per sack of cement—and intermediate grade billet or rail steel.

Reinforcing and Temperature Steel: Bond stress is based on the use of plain steel bars. Reinforcing and temperature steel shall be placed properly as shown in the typical Longitudinal Section and securely wired. In all slabs $\frac{1}{4}$ -in. round bars shall be placed on not more than 12-in. centers normal (at right angles) to the main reinforcement. Welded steel fabric of equivalent effective area may be substituted for the $\frac{1}{4}$ -in. round bars. To further minimize the effect of shrinkage and temperature the recommendations of the 1928 Building Regulations of the American Concrete Institute should be followed.

Anchorage: Longitudinal steel shall be hooked at the supports or extended into the adjoining spans as shown in the typical Longitudinal Section to provide special anchorage.

Construction Details

Typical construction details are shown in the drawing, Solid Slab Concrete Residence Floor. In this typical design the unsupported span is limited to 16 ft. Longer spans require supports and these may be bearing walls or reinforced concrete beams as shown in the Longitudinal



A concrete floor may be cast monolithically with the basement walls and beams or basement partition walls

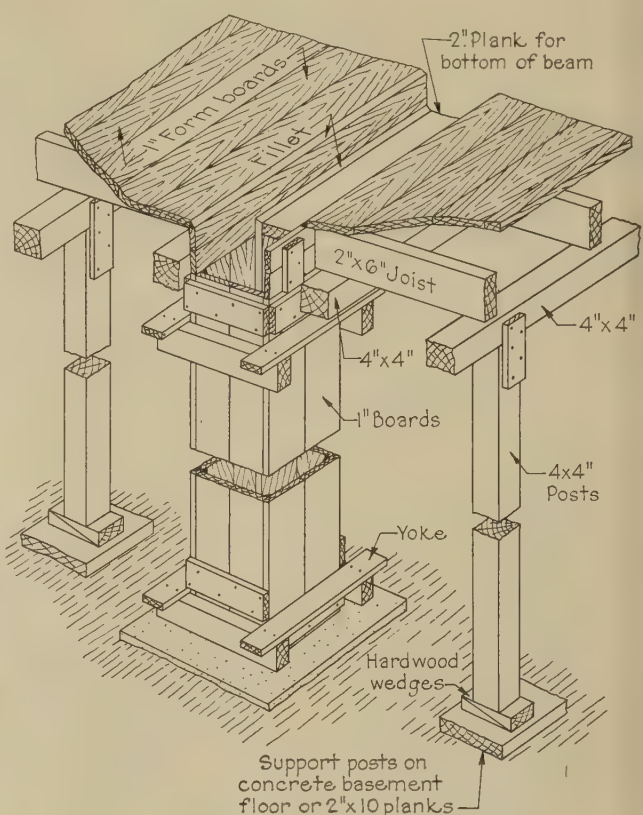
Section. Also, a bearing wall or beam of the same design is required under any first floor partition which carries a load from the second floor.

When bearing walls or beams are required as supports, the walls or the forms for concrete beams should be built first. Posts or stringers for supporting the false floor, which may be made of shiplap or standard panels, are erected next.

A tight false floor having sufficient strength to support the concrete and reinforcing steel as well as the weight of workmen and equipment required to place the concrete is the principal part of the form work. This false floor usually is built of 1-in. shiplap supported by 2- by 6-in. joists placed on 2 ft. 6-in. centers. Posts and stringers of 4- by 4-in. stock support the joists. The maximum spacing of posts for a 6-in. concrete slab is 4 ft. The posts rest on planks, usually of 2- by 10-in. stock, to pre-

vent settling. Two hardwood wedges are placed between the base of each post and the plank so that any difference in level may be corrected by adjusting these wedges. Typical forms for a solid slab floor are also shown.

Panels of standard size, which can be used on future jobs, may be employed to form the false floor. These panels may also be utilized in forming monolithic con-



Typical column form showing forms for solid slab floor

crete basement or foundation walls and for roof sheathing. However, the principal economy in using panels is that labor and time are conserved in dismantling and rebuilding when forms are to be used a number of times. In addition, the use of panels results in longer service from form lumber. When panels are used, they are usually clamped or bolted together to secure greater rigidity and accurate position.

Reinforcing

Reinforcing steel is placed after the form work is built and after all conduits or pipes have been installed, or openings provided for them in the floor slab. Size and spacing of the steel can be determined by referring to Tables 1, 2 and 3. The bars should be supported $\frac{3}{4}$ in. off the false floor, with alternate bars bent 45 degrees as shown in the Longitudinal Section. The bars should be supported $\frac{3}{4}$ in. above the forms on small pieces of concrete or on chairs. The ends of bars should be bent so that they are at least $\frac{3}{4}$ in. from the top, bottom and edge of the slab, as shown in the Longitudinal Section. This $\frac{3}{4}$ -in. covering of concrete gives the steel protection against possible corrosion or fire.

As stated in the notes pertaining to Tables 1, 2 and 3, $\frac{1}{4}$ -in. round bar reinforcement on not more than 12-in. centers or welded steel fabric of equivalent effective area is laid in the top part of the slab, $\frac{3}{4}$ in. below the surface, when the concrete is placed. Temperature rein-

(Continued on page 54)

Reinforced Concrete Design Simplified

Chart N—Long Columns

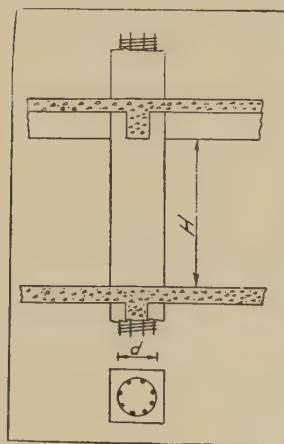
By PROF. JAMES R. GRIFFITH

Professor of Structural Engineering, Oregon State Agricultural College, Corvallis, Ore.

Joint Committee Specifications

$$P'/P = 1.33 - h/120 R$$

H/R more than 40



THE load permitted on columns in which the ratio of h/R is greater than 40 is reduced by the Joint Committee as the ratio h/R increases. Chart N has been designed to give that portion of the normal column load permitted.

Application of Chart N

In the last issue a column with spiral reinforcing was designed for a total load of 400,000 lbs. The following details were obtained:

Column

Dimensions

Overall = 24 in. by 24 in.

Core diam. = 20 in.

Height = 12 ft.

Steel

Longitudinal

Ten— $1\frac{1}{8}$ -in. square bars.

$A_s = 12.6$ sq. in.

Spiral

20 in. diameter.

$\frac{3}{8}$ -in. round.

$2\frac{1}{4}$ -in. pitch.

Percentage = 1.0.

In the last issue, the ratio h/R was checked to see that it came under 40, the allowable maximum value. This ratio can be quickly checked by Chart N with an isopleth through (diameter = 20 in.) and (height = 12 ft.). This isopleth will intersect the right scale off the sheet, indicating that the value of P'/P is greater than 1.0. When the intersection gives a value of P'/P less than 1.0, it is an indication that the ratio h/R is greater than 40.

Taking the same column diameter and load with an unsupported height of 20 ft., the isopleth on Chart N indicates a ratio

$$P'/P = 0.931$$

$$\text{By formula, } P'/P = 1.33 - \frac{h}{120 \times .417} = 0.93.$$

The column must be designed for a load of

$$P = \frac{400,000}{0.931} = 430,000 \text{ lbs.}$$

From Chart M the following values were then obtained:

$$p = 0.0433.$$

$$A_s = 13.5 \text{ sq. in.}$$

From Chart C:

Use nine— $1\frac{1}{4}$ -in. square bars.

$$A_s = 14.0 \text{ sq. in.}$$

The necessary spiral is:

$$\text{Percentage} = \frac{4.33}{4} = 1.08.$$

This is so slightly over the percentage of the same spiral used before that it would probably be used.

Diameter = 20 in.

$\frac{3}{8}$ -in. round.

$2\frac{1}{4}$ -in. pitch.

Percentage = 1.0.

Joint Committee Specifications

The Joint Committee specifies "The permissible working load on the core in axially loaded columns which have a length greater than 40 times the least radius of gyration of the column core ($40R$) shall be not greater than that determined by the formula

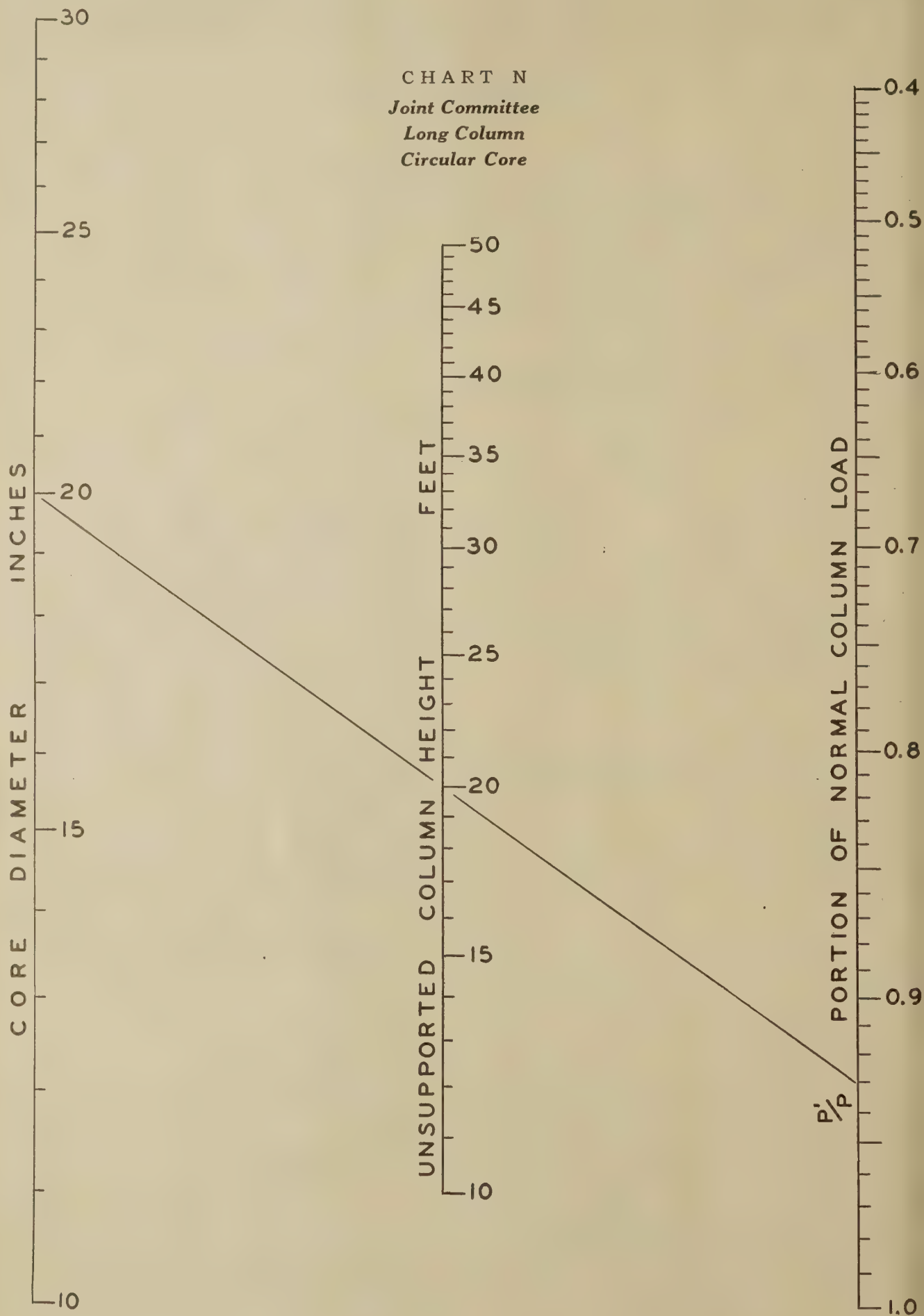
$$P'/P = 1.33 - \frac{h}{120 R} \quad \text{Eq. 1-N}$$

P' = Total safe axial load on long column.

P = Total safe axial load on column of same section whose (h/R) is less than 40.

R = Least radius of gyration of column core."

CHART N
Joint Committee
Long Column
Circular Core



Those wishing to correspond with Professor Griffith should note the change of his address from Chicago, Ill., to Corvallis, Ore.

Construction of Chart N

The ratio of the allowable load on a long column to that of a short one is found by the expression

$$P'/P = 1.33 - \frac{h}{120 R}$$

Eq. 1-N

which can be transposed into the form

$$h = 120 R (1.33 - P'/P)$$

But $R = d/4$ (for circular core). So the expression can be written

$$h = 30 d (1.33 - P'/P)$$

(1)

Expression (1) is not exactly true for square and rectangular columns. Rectangular columns (to be discussed in the next issue) give

$$R = 0.288675 d$$

where (d) is the least dimension. Expression (1) is for a value of $R = 0.25 d$, which is probably as close as our knowledge of such columns warrants.

Expression (1) is still in a form not suitable for nomographic construction. However, if I let that part of the expression $(1.33 - P'/P)$ be one variable

$$f = 1.33 - P'/P$$

Expression (1) will then simplify to the form

$$h = 30 d f$$

(2)

Expression (2) corresponds to the general expression

$$C = L^{mn/r} R^{m(1-n)}$$

Eq. 7

requiring logarithmic co-ordinates. Equating the general exponents of Eq. 7 to the actual exponents of the variables of expression (2) I have

$$\begin{aligned} mn/r &= 1 \\ m(1-n) &= 1 \end{aligned}$$

If equal co-ordinates are used on the (L) and (R) scales, the ratio (r) will be unity. Substituting this value of ($r = 1$) and solving these last two expressions simultaneously for values of (m) and (n), I have

$$\begin{aligned} n &= \frac{1}{2} \\ m &= 2 \end{aligned}$$

The central scale having values of (h) will then lie half way between the two outside scales and have co-ordinates

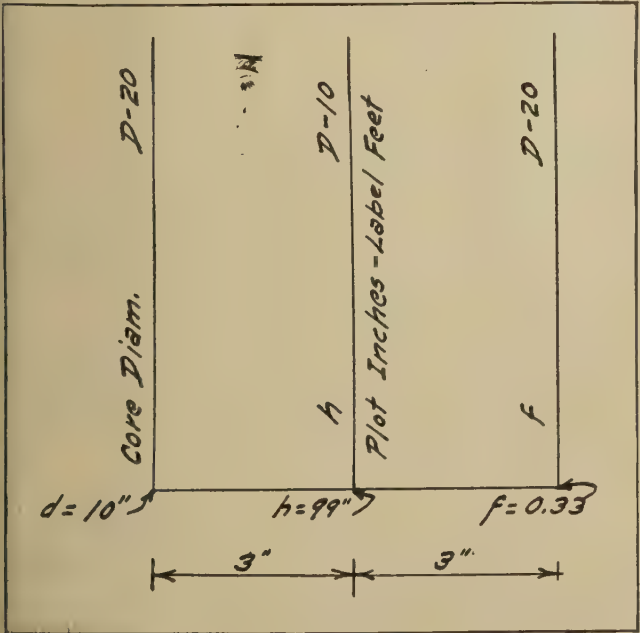


Figure 1-N

one-half the size of those used on the (R) right scale. However, I am not interested in values of (f). So I have prepared a table showing the relation of (f) to (P'/P). Table 1-N gives but a portion of these values. In plotting the right (R) scale these values of (f) were plotted but labeled their corresponding values of (P'/P).

TABLE 1-N

P'/P	$f = 1.33 - P'/P$
0.1	1.23
0.2	1.13
0.3	1.03
0.4	0.93
0.5	0.83
0.6	0.73
0.7	0.63
0.8	0.53
0.9	0.43
1.0	0.33

Figure 1-N gives the complete information by which the original of Chart N was plotted. In plotting values of (h) on the central scale inches must be used. But at the proper location the values of feet were labeled.

Those readers desiring a more exact solution for square and rectangular columns can construct a similar chart to Chart N with the central scale shifted to a value at the construction isopleth of

$$\begin{aligned} h &= 34.65 d f = 34.65 \times 10 \times 0.33 \\ &= 115.5 \text{ in.} = 9.625 \text{ ft.} \end{aligned}$$

Modernizing a 1915 Products Plant

(Continued from Page 24)

Make 2200 Block Daily

All work of installation was carried on under the supervision of the writer and of Jack Franklin, local representative of the Consolidated Concrete Machinery Co. Now for the rated capacity of the plant. As we are now operating, the production is approximately 2200 units a day, varying, of course, with the size of units manufactured. One mixer man, located overhead, mixes for the machines and assists in unloading gravel coming to the plant in battleship cars; one man handles racks for both machines; on the Anchor an offbearer and machine operator comprises the crew, alternately making blocks and offbearing; on the Papke, most of the time, one man operates the machine and does his own offbearing.

There was some skepticism on the part of many that the 50 per cent air space block would be a success. In fact, we had had so many people tell us this that we began to doubt ourselves. But we felt that with positive control of the mix by use of the weighing device for aggregate and with control of the water by means of automatic meter control, that we would have no worries. I believe we failed to say anything about these meters. A year ago we put one on the 9-ft. Ideal then in use and found it so satisfactory that we added another for the 14-ft. mixer when we made our change. This device is sold by the Automatic Meter Sales Company of Milwaukee and is a great help in keeping a uniform mix.

Well, to make a long story short, we started testing six days after operations commenced, for we wanted to be sure of ourselves. The tests were really startling. We thought our mix a lean one, but six- and ten-day tests came so close to the strength we had contemplated at 28 days that we were considering another cut in the mix. However, with winter on us in full blast we decided against this as we planned to yard all blocks within 24 hours.

Cement and Water Paints

Demand for Color and Harmony in Architecture Increases Field for Cement Paints—Cement and Water Paint—Information on Preparation of Surface, Mixing and Application and Curing

THE present-day tendency toward color and harmony in architecture is rapidly increasing the field for paints that will effectively apply to concrete surfaces. To conform to the modernistic trend, concrete surfaces are being painted and even old surfaces are being made new with paint in an effort to restore their original beauty and brilliance.

Cement paints are particularly suitable for redecorating old stucco surfaces. While many unusually beautiful and effective architectural treatments are possible with stucco, such surfaces frequently become soiled. This is especially true in densely populated areas. Cement paints which include portland cement as the bonding agent and water as the vehicle adhere readily to such surfaces, preserving the original texture and becoming an integral part of the stucco itself as they renew the color of the surface.

The term *cement paint* is commonly applied to paints of three classes—lead and oil paint, cement and oil paint, and cement and water paint. Cement and water paint, when applied, serves in reality as a thin slab of stucco with the inherent properties of portland cement stucco. Paints of this group dry to a flat finish. When applied to clean concrete surfaces, these paints adhere well because of the cement-to-cement bond, but they may not bond satisfactorily to smooth surfaces such as metal, wood, glass, etc.

Cement and water paints all contain portland cement as a binding agent and such mineral pigments as are required to produce the desired color effect. They may also include such inert fillers as marble or silica dust or such organic materials as casein. It is claimed that casein, through its strong affinity for lime, unites chemically with any lime present on the surface of the concrete to form an insoluble mass that adds materially to the effectiveness of the paint.

Preparation of Surface

Cement and water paints are successfully applied over clean concrete surfaces that have proper suction.

If the surface to be painted is old, it should first be washed with a dilute solution of hydrochloric (muriatic) acid—one part concentrated acid with 10 to 15 parts of water—to remove all accumulated oils, dirt, grease, efflorescence, etc. The surface should then be washed thoroughly with clean water to remove all traces of the acid.

If the surface has been painted before, the old coating of paint should be removed with a wire brush and the surface then given an acid bath as just described.

New concrete that has been placed in oiled forms must likewise be treated with an acid wash to remove all traces of oil that may have adhered to the surface.

Fresh concrete surfaces such as stucco can be painted after they have been properly moist-cured for at least two days and then allowed to dry out thoroughly. It is unnecessary to treat them with acid.

Mixing and Application

Cement and water paints should be mixed with clean

water within a few hours of the time they are to be used. Manufacturers' specifications should always be followed carefully. If allowed to stand in a wet, mixed condition, a cement and water paint will be practically worthless.

The paint may be applied to a dry or a uniformly dampened surface. Here again it is advisable to follow the recommendations of the manufacturer. If specifications call for a damp surface, consideration should be given to the absorptive properties of the surface or wall to be painted. For example, there will be considerably more suction in a stucco wall than there will be in a wall of monolithic concrete. The former, consequently, will require more wetting.

Cement and water paints may be applied with either brush or spray equipment. If the paint is brushed on, it is best to apply it with a large, stiff brush. The paint being used should be kept thoroughly stirred. Spray applications may be made with either hand or power equipment. And care should be taken so that the paint is well stirred. This will prevent segregation or lumping, as it is sometimes called. Any runs that develop on the surface should be brushed out immediately. When the day's work is done the spraying equipment should be cleaned thoroughly with clean water.

Curing Cement and Water Paint

Proper curing of a surface coated with cement and water paint is absolutely essential. Since cement and water paints are actually thin slabs of portland cement concrete, it is important that they be completely hydrated. Their bond to the surface and the hardness of the paint depends largely on this hydrating process.

As soon as the first coat is hardened sufficiently to withstand it, a light spray of water should be turned on the surface. This should be repeated at regular intervals for at least two days to insure sufficient hydration. Another method of curing is also frequently used, that of hanging damp burlap in front of the surface but not touching it. This should be kept damp for at least two days.

Cement and water paints serve not only as excellent decorative finishes but they will also preserve this architectural effect on either interior or exterior walls. However, cement and water paints should not be considered as substitutes for stucco, but they are particularly suitable for renewing old stucco surfaces. Durable decorative effects can be effected through their use when correct methods of surface preparation, application and curing are strictly followed. Cement and water paints are not suitable for painting concrete floors or sidewalks and should not be used on smooth, non-absorptive materials.

Cincinnati Products Officers

The following officers were elected for the coming year at the May 16th meeting of the Cincinnati Concrete Products Association at Cincinnati, Ohio:

Herman Foreste, President; Albert Rienhart, vice-president; George F. Potter, secretary-treasurer.

Design of Concrete for Machine Made Pipe

A Discussion of Some Practical Problems in Concrete Pipe Manufacture, Stressing the Need for Workable Concrete

By E. F. BESPALOW
Sales Engineer, Hollywood Concrete Pipe Co., Inc.

“THE strength of concrete depends on the ratio between the volume of mixing water and the volume of cement (w/c). As long as the mixture is workable, the smaller the water-cement ratio, the stronger the concrete. Thus decreasing the quantity of mixing water adds to the strength of concrete.”

The above principle of concrete design has been expounded in print and by word of mouth until it has been firmly imbedded in the minds of all men working with concrete. “Less water gives stronger concrete” has become a fixed law in the minds of a large majority of engineers and others who have anything at all to do with concrete work. It has become fixed so firmly in the minds of most of them that they have lost sight of the conditions under which this law holds true; because it does not hold true under all conditions. In fact under certain conditions of the concrete the very opposite of the law is true, i. e., “more water gives stronger concrete.” In the original statement of the water-cement ratio principle of concrete design, there is one condition made and that is, “as long as the mixture is workable.” It is this amending clause that is lost sight of by some engineers and it is about this class of concrete that this article is concerned.

Concrete such as is used in the manufacture of pipe by the tamping type and packerhead type of machine is not workable concrete in the generally accepted sense of the term. It requires the tamping or packing of the machines to work it into a dense mass. All excess moisture is brought to the surface by the effect of the tampers or packers on the machines and forms a water-web marking on the surface of the pipe which is very readily distinguished. If the water-web marking is not present on the surface of the pipe, it indicates that an insufficient

amount of water has been used in the mix and the pipe is not as strong or durable as it should be.

Effect of Water Content

Figure 1 indicates the position on the curve in which lies the concrete used in machine made products. From this figure it can readily be seen that the more water used in the mix the stronger the concrete will be. The amount of water used in the manufacture of machine

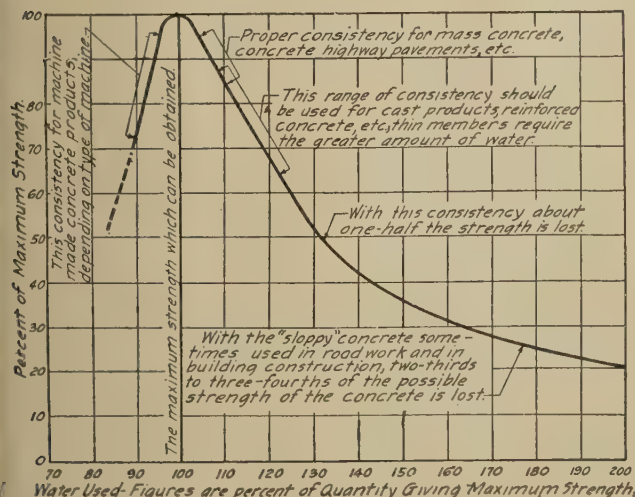
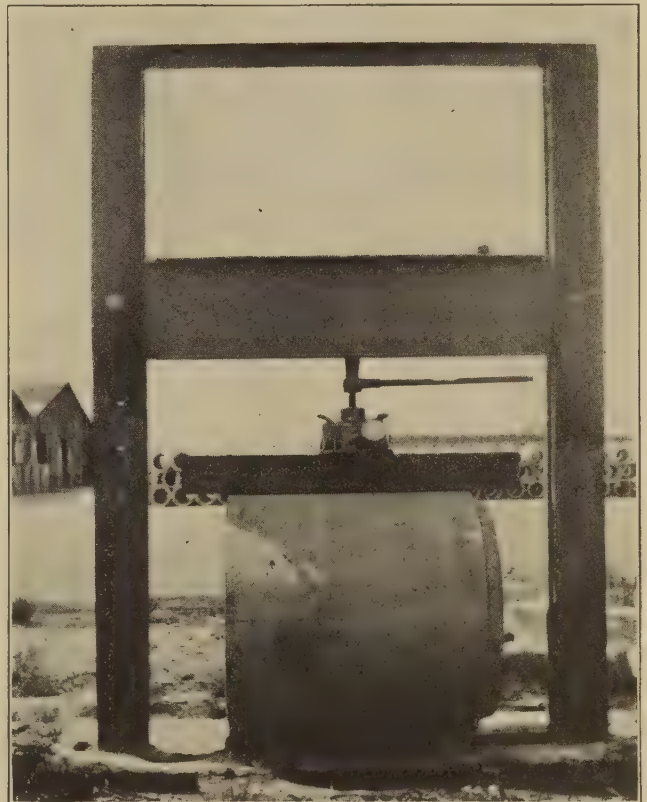


Figure 1



Thirty-inch reinforced concrete pipe being subjected to the crushing test

made pipe* is limited by certain manufacturing details. If too little water is used the pipe will “burn,” that is, the mortar coating which is formed on the inside surface of the pipe will become blue in color and blister or peel off. This mortar seal coat is formed by the action of the core in the tamping type of machine and the packers

*The references in this article to machine-made pipe refer only to the tamping type and packerhead type of machine and do not include the centrifugal type of machine which utilizes workable mixes of the so-called wet variety.

in the packerhead type of machine. The heat caused by the friction of the core or packers against the concrete dries the water out of the concrete in the surface of the pipe and if there is insufficient water used in the mix, there will not be enough present to withstand the drying action and still leave sufficient water present to form a cement paste. Pipe which shows a burned interior surface will not pass a strength test or hydrostatic test satisfactorily. If too much water is used in the mix, it becomes impossible to remove the forms from the pipe when they reach the curing room, or the pipe settle out of shape or will not remain standing after the jackets are stripped. The object in machine made pipe is to use as much water as possible and still be able to strip the jackets satisfactorily. When this is done, it will be found that the concrete is as strong as it is possible to make it, for the given mix and aggregates used.

The grading of the aggregates affects the strength of concrete only insofar as it affects the percentage of water which may be used in a given mix. A fine graded sand requires more water for a given consistency than a coarse graded sand and therefore we always hear that fine sand gives weaker concrete than coarse sand. But again this holds true only for workable mixes of concrete, because in the concrete used in machine made pipe a fine sand will give as strong a concrete as coarse sand because of the increase of water content of the mix. This has been proven by repeated tests on 6-in. by 12-in. cylinders made of the concrete used in the manufacture of machine made pipe made with 1:2:2.4 mix using sand with a fineness modulus of 1.98 to 2.08 and coarse aggregate with a fineness modulus of 5.67 has given compressive strengths at 28 days which range from 4,800 to 6,800 about 0.4, which is approximately 3 gallons of water per lbs. per sq. in. The water-cement ratio used averages sack of cement and gives the maximum strength obtainable.

Table 1 shows the typical sand grading and Table 2 the typical grading of the coarse aggregate used.

Table 3 shows the fineness modulus used in the various sizes of pipe. These are obtained by combining the fine and coarse sands and the $\frac{3}{8}$ -in. and $\frac{5}{8}$ -in. stone in the proper proportions to secure these given fineness moduli. Experience has proven that these fineness moduli give the best results from all points of view. The strength, hydrostatic qualities, absorption and productive capacity must all be considered in establishing a definite modulus for any size pipe. A higher fineness modulus will give strong pipe with low absorption and high productive capacity; but will give a pipe with poor hydrostatic qualities and this fact acts as a limiting factor toward too coarse a grading. A lower fineness modulus will give pipe with excellent hydrostatic qualities but will cut down the productive capacity and will increase the absorption. All of these factors have to be taken into account in establishing the fineness moduli as shown in Table 3. The test report shown here is typical of the results obtained and proves the soundness of the design used.

TABLE 1

	Florida sand	Coarse sand	Fine sand
	Per cent	Per cent	Per cent
Retained on No. 4	0.0	0.0	0.0
Retained on No. 8	0.0	5.0	0.0
Retained on No. 14	6.0	15.0	2.0
Retained on No. 28	36.0	45.0	9.0
Retained on No. 48	78.0	83.0	33.0
Retained on No. 100	96.0	98.0	77.0
	F.M.—2.08	F.M.—2.46	F.M.—1.21

TABLE 2

	$\frac{3}{8}$ -in. Stone	$\frac{5}{8}$ -in. Stone
	Per cent	Per cent
Retained on $\frac{3}{8}$ -in.	0.0	11.3
Retained on No. 4	37.0	65.2
Retained on No. 8	82.0	91.0
Retained on No. 14	100.0	100.0
Retained on No. 28	100.0	100.0
Retained on No. 48	100.0	100.0
Retained on No. 100	100.0	100.0
	F.M.—5.19	F.M.—5.67

TABLE 3

Size of Pipe	Fineness Modulus
4-in.	3.63
6-in.	3.63
8-in.	3.63
10-in.	3.77
12-in.	3.82
15-in.	3.87
18-in.	3.92
21-in.	3.96
24-in.	4.00
27-in.	4.00
30-in.	4.04
36-in.	4.04
42-in.	4.04

TEST REPORTS

CRUSHING TEST

Size	Load	Load per Ft.	Minimum Required
8-in. plain	5,600	1,867	1,000
8-in. plain	4,500	1,500	1,000*
8-in. plain	4,500	1,500	1,000*
8-in. plain	4,500	1,500	1,000*
8-in. plain	4,500	1,500	1,000*
8-in. plain	4,500	1,500	1,000*

*Load applied but not crushed.

Hydrostatic Test—O.K.

Specifications:

- 12-in. RC pipe, 2,000xD, not over 6% absorption.
- 12-in. Sewer, 1,540 per ft., not over 8% absorption.

Specimen	Size, In.	Load	Load per Ft.	Minimum Required	Absorp. Per cent
12-in. RC	12	8,500	2,833	2,000	4.2
12-in. Sewer	12	6,400	2,133	1,540	4.5

Hydrostatic—O.K.

Great British Concrete Flood Wall Completed

The final gap in the great sea defense wall at Fleetwood, England, was closed recently, and with the meeting of the northern and southern portions of the wall the town is now protected. The wall varies in height from 8 to 12 ft., is 6 ft. 6 in. thick at the base and 3 ft. 6 in. at the top, and with a coping of 2 ft. 6 in., is calculated to withstand a 38-ft. tide—8 ft. higher than normal. Over 2,100 tons of cement were used in its construction.

Attention is now being directed to the construction of the remaining length of concrete wall on what is at present the least protected part of the coastline.

Concrete for the Builder

A NEW DEPARTMENT

IN last month's issue we introduced a new department in which material selected particularly for the concrete builder—the contractor who specializes in the construction of foundations, apartment houses, stores, residences, filling stations, driveways, concrete floors, etc., etc.,—is published.

It was decided that there was a real need for articles of this kind. A vast amount of additional business is awaiting the concrete builder who is wide-awake and energetic enough to go after it. Realizing this condition, the new department was started with the definite object in view of helping the concrete builder to get some of these additional jobs.

Each month, in this department, the concrete builder will find some new suggestions that will help him to expand his activities. For instance, this month there are several articles on the subject of filling stations. One of these gives detailed information on filling station design—how to place each of the units needed in a well equipped station. Two typical designs with architectural sketches, one for an inside lot and one for a corner lot, are presented. Then there is an article telling in detail how to build driveways for filling stations. Armed with this information, the concrete builder can go out in his community and land some filling station work.

In addition there are articles on the fundamentals of making good concrete, cement paints and other subjects of interest to the builder. The first article of a series giving practical information on how to build concrete floors is presented in this issue. This first floor article deals with the solid type of floor slab. It will be followed by articles on the ribbed floor and on the tile and joist floor.

Design tables and form detail sketches accompany all these stories.

—‡—

WE have great plans for future issues, too. One by one, we will take up other suggestions for increasing the builder's business. Every possible structure that the contractor will be called upon to build will be covered. Our editors will visit builders in every section of the country, getting their slants and securing information to pass on to other builders. We expect shortly to publish articles telling just how this builder or that builder increased his business. These will be man-to-man stories secured in the field from the builder himself.

—‡—

WE want you to feel that this is *your* paper. Ask us for help on any of your problems. Write us your experiences. They may be of help to other builders. An exchange of ideas always is worth while. You get the benefit from the other man's experience and he gets the benefit from yours. You gain most because there are more of the other men than there are of you.

—‡—

THIS idea of *selling* is a new one for most concrete builders. It is true that some builders are already doing something along this line. Once in a while you see an advertisement in the paper in which some builder makes a bid for more business. But even this is unusual.

It can't be repeated too often that nowadays any one who is going to get his share of the construction dollar has to go after it aggressively. Too many other people are out after it. There is real competition and to win in a competitive market requires *selling*.

Concrete for Permanence

The Making of a Watertight Paste

(Installment 2)

The Five Requirements for Durable Concrete. (Summarized from Installment No. 1 in the June issue):

1. Durable, impervious aggregates.
2. A watertight binding medium—the hardened cement-water paste.
3. A mixture that permits complete incorporation of the aggregates in the paste.
4. Methods of mixing and placing to secure a uniform homogeneous mass.
5. Adequate protection and curing.

By F. R. McMILLAN

THE cement-water paste in which the aggregates are incorporated serves two widely different purposes in the making of concrete. First, it acts as a vehicle to float the aggregates and gives plasticity to the mass during placing. Second, through the chemical action of the cement and water, it becomes the binding medium upon which the concrete must depend for most of its useful properties. This dual purpose of the cement paste fixes rather narrow limits to the proportions for durable concrete. If only sufficient water is used to meet the chemical requirements of combination, the paste will not be sufficiently plastic to be of use as a vehicle for the aggregate. If too much water is used in an effort to get greater mobility, it reduces the strength and watertightness of the paste and thus lowers its resistance to weathering.

The effect of quantity of mixing water on the strength of concrete is widely recognized. So also is the effect of curing. In the case of watertightness, however, the importance of these two factors is not so well understood. In Fig. 1, both the quantity of mixing water and the degree of curing are represented in the tests of permeability of concrete. In this figure, which is taken from the Building Research Technical Paper No. 3, Department of Scientific and Industrial Research, London, the permeability of 1:2:4 concrete is shown for different quantities of mixing water and different ages at test.

In these tests, the difference in curing is represented by difference in age. It can be seen, however, that if the curing process were completely interrupted at some point, as for example at 7 days, nothing could be added either to strength or watertightness by further increases in age so long as the bar to continued curing remained. The marked difference in leakage, through these test specimens at the different ages, shows the extreme importance of the completeness of the chemical reactions on watertightness.

The increase in leakage with an increase in the quantity of mixing water is also seen to be very pronounced. The rate of flow in the 28-day tests for the concrete with 8.5 gallons of water per sack of cement is nearly 4 times as great as that for concrete with 6.8 gallons per sack. The ratio is even greater for the 14-day test. In Fig. 1, it is important to note the rise in the curves for water-cement ratios less than about 6.8 gallons per sack. This

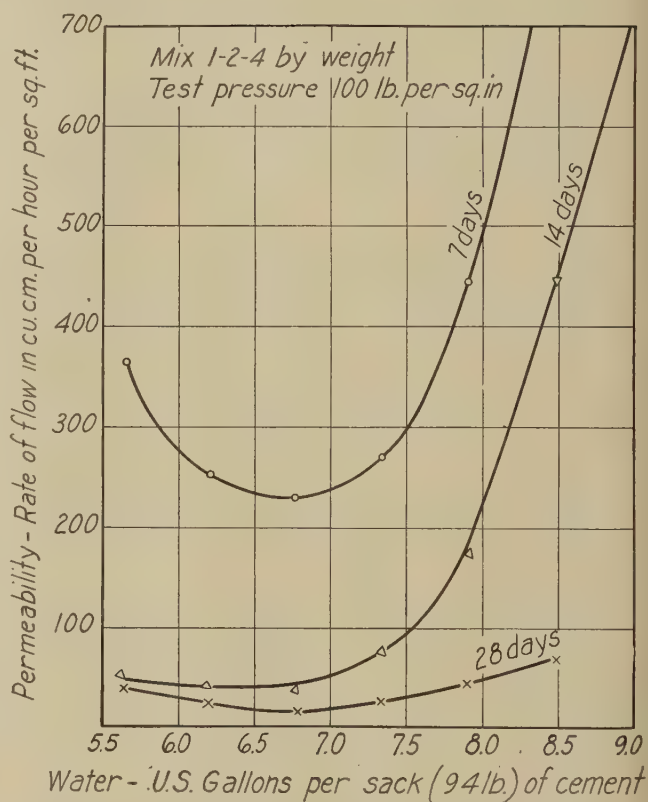


Fig. 1—Water-cement ratio permeability relation for a 1:2:4 concrete taken from Building Research Technical Paper No. 3, Department of Scientific and Industrial Research, London

is due to the fact that the 1:2:4 mix became too stiff to mold properly for the low quantities of water. This point is to be covered in a later installment bearing on the proportion of aggregate which can be safely used with a sack of cement and any fixed quantity of water.

In the next installment, dealing further with the making of a watertight paste, it will be shown that these factors affect the quality of the concrete only through their effect on the quality of the paste.

The A B C's of Merchandising

What Pre-Selling Is and How the Concrete Builder Can Benefit from It

PRE-SELLING prepares the way for selling. It is neither a duplication of effort nor an unnecessary gesture. It is a vital part of any merchandising campaign. The page after page of advertising that you read each day is paving the way for the purchase you will eventually make.

There are hundreds of prospective purchasers of concrete construction in your community but how will they know that you are the man they should get to do the job? If the prospect has never heard of you it will require more sales effort to close the deal than if he had read your advertisement in the paper, seen your signs on jobs under construction or noticed your trucks hauling materials. This advantage of what we might call previous acquaintance applies to every type of structure that you sell. Become acquainted with your prospects and increase your business. Oil companies are prospects.

Have You Built Any Filling Stations?

Filling stations are so common that we often forget they have not always existed. You can probably remember the grocers and druggists who advertised gasoline and carried it out to their customers in red cans. Later the more progressive dealers installed small pumps along the curb and finally the demand for faster service led to the development of the drive-in service station. How much business have you obtained from this growing industry?

Gasoline and oil are necessities for the auto but the large number of stations offer to the buyer an opportunity to choose where he shall spend his money. Oil companies have learned by experience that a bright attractive station will draw more trade than a drab, ill-kept one. They also know that even though the neighborhood motorist may be a steady customer of a certain station that the business of tourists and motorists from other sections is attracted largely by the appearance of the service station.

The station house catches the driver's eye, especially if it is of good appearance. The architectural lines of the building and the color and texture of the surface are important in creating an opinion that the filling station he is approaching is clean and well equipped to give him good service. The concrete contractor is well equipped to erect a service station that will draw business and give to the owner a permanent structure that meets all of his requirements.

The storage tank foundations must be strong and solid so that there will be no settlement to damage his piping and cause leakage losses. In many cities the building ordinances require that the tanks be encased in reinforced concrete. Fire-safety and elimination of explosion hazards are of utmost importance in station construction.

Sell the Driveway, Too

Concrete drives are desirable for filling stations because they are clean and easy to keep clean. There is no dust, no rough surfaces to bump over and no mud holes to splash the cars waiting for service. In winter the smooth surfaces are easy to keep free of snow and ice. Greasing pits are usually built as a part of the pavements. When

built of concrete there is no danger of damage by oil fires and better yet, they are easy to keep free of oil that creates the hazard.

Beauty of the station house may be obtained very economically with concrete masonry finished with textured portland cement stucco and covered with a colorful roof of concrete tile. Stucco can be made a part of any type of architecture and the texture varied to suit the design.

Filling station contracts and other business may be obtained in two ways. First, by watching the building notices and then going after the job. Second, by pre-selling the prospect that you are qualified to build the job and getting a signed contract before the job is announced to the public. By depending on the first method you often lose the job because some one else has the job pre-sold; if the job is still open the competition becomes so keen and the selling cost is so high that profits are sometimes very low.

Do Some Pre-Selling

By contacting the oil companies or other prospective builders even though there is no construction in sight at present, you become acquainted with their problems and they become acquainted with your ability to do first class concrete work. Regular contacts between personal calls may be maintained by letters and newspapers or building magazine advertising. The purpose of pre-selling is to plant an idea in the prospect's mind, bring it along with well planned interviews until it changes into desire, and finally into action in the form of a purchase.

Pre-selling talks filled with technical phrases and price quotations do not usually plant ideas. Ice companies found their markets slipping until they discovered that ice at 40 cents per hundred pounds did not interest their customers. Competitors' advertising had created a desire for food preservation, new cold desserts, cooling drinks and service. These sales ideas brought results and the thousands of families who did not even own an ice box were educated to the advantages of food preservation. A new sales appeal was needed to restore the market for ice.

The same is true of the concrete contracting industry. The oil company is not in the market for 50 yards of concrete having a slump of four inches and testing 2,000 pounds per square inch at 28 days. What they are in the market for is tank foundations that will not crack, greasing pits that are watertight, driveways that are permanent and serviceable and a filling station house that attracts the trade.

Park Business

The park commissioners want tennis courts that do not require maintenance, swimming pools for relief from summer heat and stadiums that provide comfortable seats for the public to watch others play. The home owner wants a driveway that is attractive, a lily pool for his garden and perhaps a path of stepping stones.

Plant an idea by pre-selling every type of structure which you build and you will be sold on the personal selling plan as a means of increasing your business.

Automobile Service Stations

THE service station construction field offers many opportunities for the concrete builder to increase his business. The advance of the filling or service station has been rapid, along with the increase in the number of automobiles, trucks and busses and the consequent increased demand for gasoline and oil. Even now the present requirements of the motoring public apparently are not being fully met. In fact, there is a need for new stations as well as renewed stations. And whenever a filling station is built or modernized there is a preponderance of concrete construction required.

Whether the station is being established by one of the oil companies as part of a chain or whether a local concern is planning it, the concrete builder is the logical one to build it. At least, he is the logical one to do the greater part of the work. Not only that, it may be profitable for him to promote the construction of stations in locations where none exist but where they are really needed to supply the increased demands for gasoline, oil and service.

THERE are four general types of filling stations, grouped as follows:

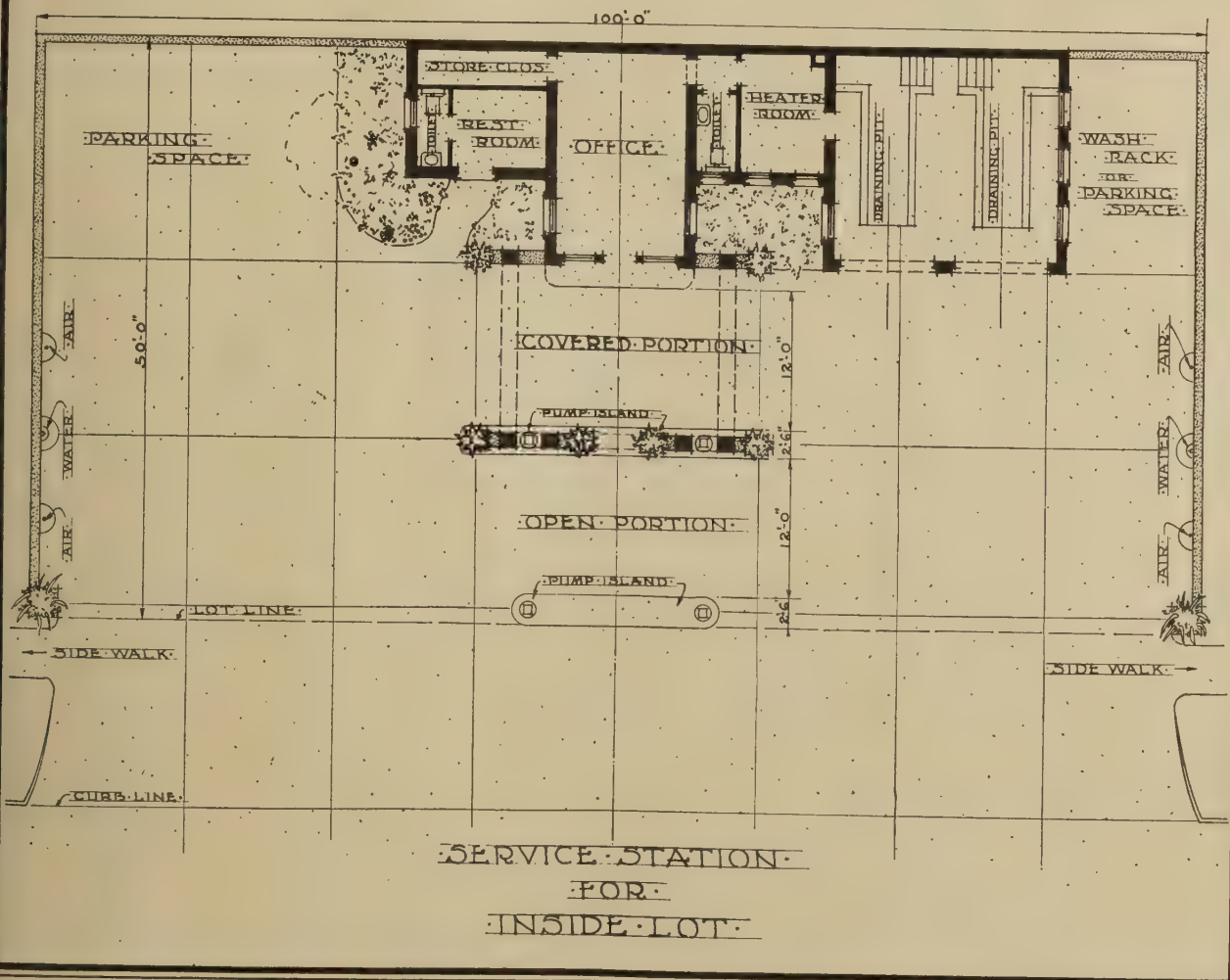
First, filling stations located in the business district: A station in the business district is usually restricted in size and may have one or two concrete drives or an all-over concrete pavement, two or more gasoline pumps and a small building for housing the oil and providing shelter for the attendants. It may or may not have drain or greas-

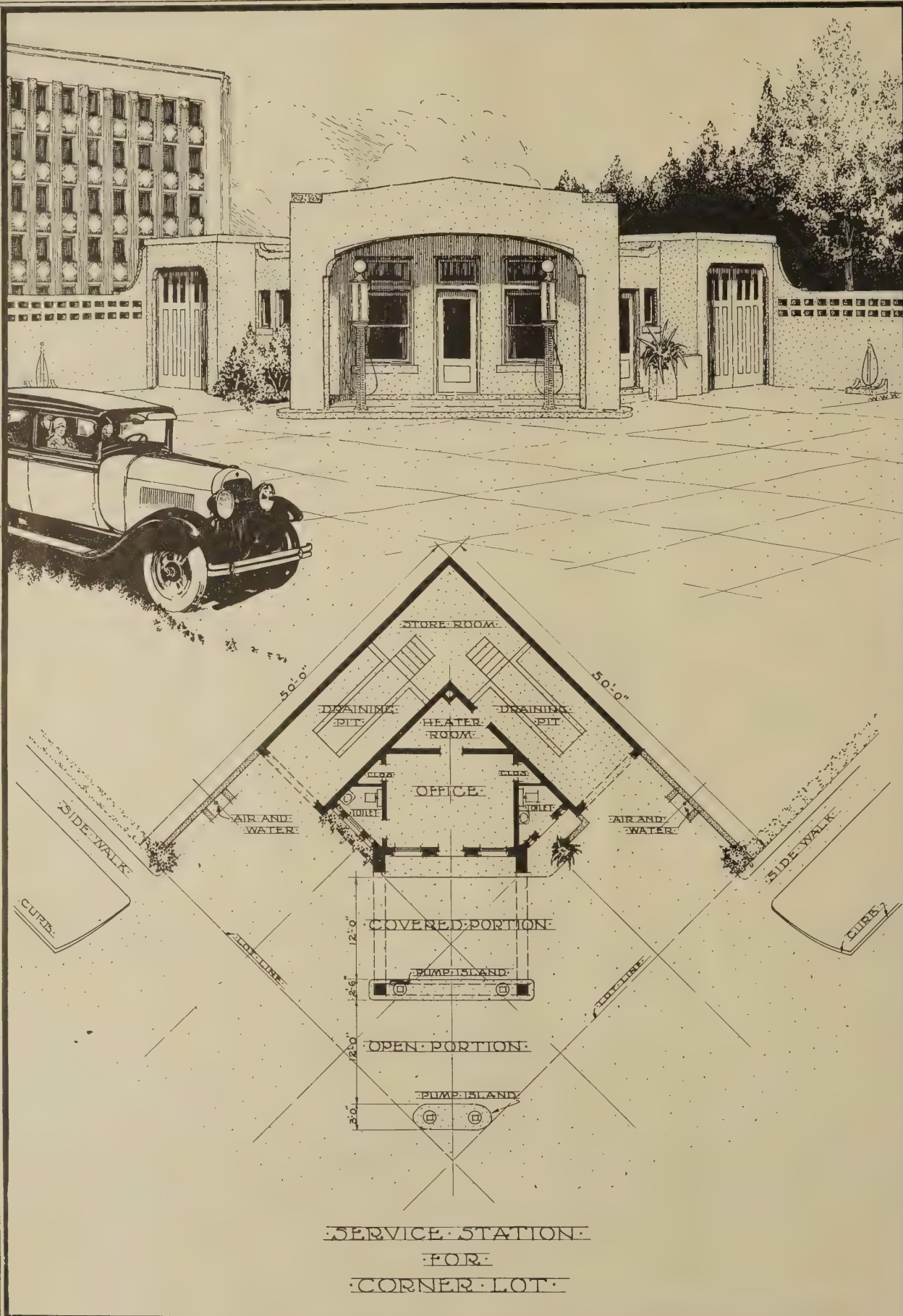
ing pits, depending upon the amount of such business that can be developed. Usually only a small building is needed with just enough space for three or four oil outfits, air tank and compressor, heater and desk space for the attendant in charge.

Second, filling stations in residential sections on arterial highways: In this group the station draws most of its trade from transients, although a goodly portion is some-



Concrete driveways for filling stations offer an opportunity for increasing the volume of work done by the builder. Complete instructions for building driveways of this type are given in this issue





times drawn from the neighborhood. Such stations usually handle two or three grades of gasoline, several grades and brands of oil (if an oil company station it should have on hand all grades of its own oil and gasoline) and there should be drain pits or greasing, air and water service and ample parking space. The building itself should have an office and sales room, with a men's toilet room opening from it, and a rest room for women with a separate toilet room. The entrance to the sales room should be from the drives, while the entrance to the women's rest room should be at one side of the building and be screened from the public view. The atmosphere of the station should be inviting and the arrangement and character of the whole place be such as to appeal to the approaching motorist. There will be ample concrete construction required in the drives, pump islands, drain pits and the building itself in such a station.

Third, filling stations in residential sections whose business is dependent upon the automobile-owning people in that district and upon whatever transient business might come that way. The requirements for this group are somewhat the same as those for the second group, except that the building does not need to be quite so complete. The drives should be easy of approach, and wide and straight enough to inspire confidence in the timid driver, as many women in the neighborhood will patronize such a station. Greasing racks and drain pits are quite essential since the convenience of such a station to the people in the neighborhood is one of the best drawing points. The building itself need only be large enough to contain the oil outfits with plenty of room for the necessary furniture, equipment and toilet room. It is better to have an outside entrance for the toilet room so that it can be used without embarrassment by anyone patronizing the station.

Fourth, filling stations in small towns that handle the local trade but in reality cater to the touring public. A station in this group constitutes a more complex problem than any of the others and requires considerable preliminary study and observation of touring conditions. There is generally a need for handling certain accessories and frequently the station must be equipped to give full service to the motoring public. The building should be similar to the one required in Group Two; sales room and office, men's toilet and women's rest room and toilet. The grounds should be large enough to provide parking space without obstructing drives. There will be considerable concrete work required in building a station of this type.

Station Layout

Insofar as layout, drives and building are concerned, the following details should be considered for each of the four general types:

It is absolutely essential that the lot be large enough for the needs of the filling or service station. The size for a corner lot should be not less than 50 feet by 50 feet and preferably 60 feet by 80 feet, or longer. For an inside lot the size should be not less than 50 feet by 70 feet frontage. These sizes will allow for a small building about 12 feet by 18 feet and the installation of a concrete drainage pit. It is much better to have plenty of room and space which will be inviting to motorists than to have a crowded station into which motorists will drive only in case of absolute necessity.

The concrete drives ordinarily should be about 12 feet wide and the concrete pump island, if not carrying canopy supports, should be not less than 2 feet 6 inches wide. Where canopy supports are carried on the island, it should be at least one foot wider than the canopy supports, so that the island will form a protecting curb for the supports. The pump island or similar islands should

be at least 4 inches above the drive. Where drives are practically straight or approached by long-radius curves and where space is at a premium, the width of the drives may be reduced to not less than 10 feet 6 inches. Where drives are approached by sharp curves, it may be necessary to widen them to 13 feet or 13 feet 6 inches.

Air and water towers should be located so as not to interfere with traffic at the station. The locating of the air and water facilities on one side of the building and the drain pit on the other side is a logical arrangement.

While the vertical clearance between canopy and drive should be not less than 9 feet, the type of gasoline pumps installed will often determine this. With piston-type pumps, a clear height of 10 feet above the pump is usually sufficient, but in the case of visible pumps a clear height of 11 feet is desirable. These heights should be checked with the heights recommended by pump manufacturers.

Typical designs that are more than just places for distribution of gasoline and oil have been prepared to assist the concrete contractor in showing how concrete can be used around the filling station. The arrangement of the drives with respect to accessibility from the streets, the relation of drives to the building proper, and the location of drain or greasing pits, air and water facilities with respect to maximum service; all these have been arranged harmoniously, with good design of buildings, in the accompanying service station designs. The concrete contractor can "sell" these or equally attractive designs on the basis that they will be decided assets to the community in which they will ultimately be located. It is almost needless to say that concrete construction has been specified where possible.

Much Concrete Needed

Concrete can be used to advantage in practically all of the construction required for service stations. For example, the walls may be of portland cement stucco applied on concrete masonry or on metal lath or wire lath; the roof of concrete tile cement-asbestos shingles; the drives or pavement and islands for pump and other service facilities can be of concrete, and the pit that is needed for making oil changes or for greasing cars should be of concrete construction. In fact, there is an unlimited market for concrete in service station construction.

The concrete builder need not confine his business to building new service stations. There are countless out-of-date filling stations which can be profitably modernized. For example, the appearance of a station can be improved greatly by overcoating with portland cement stucco or by constructing an all-concrete pavement around it. The concrete contractor will be justified in inspecting stations in his locality; there may be room for improvements at each of them. Many filling station owners are ready to modernize their buildings, drives and equipment in an effort to increase their business.

In recent years many stations have gone very extensively into the handling of accessories. Others have developed the business of draining crank cases and filling them with fresh oil, to say nothing of the car washing and greasing sidelines that are now being handled by many stations. This concentrated quest after new business also means new business for the concrete contractor.

It is important that concrete contractors and prospective operators of filling stations be familiar with city ordinances governing service or filling station installations. In addition, where work is being done for an oil company the standards of the company's construction department should be studied by the builder and followed carefully.

How to Build

Filling Station Driveways

Detailed Instructions Covering the Methods Used to
Build Filling Station Driveways—Thickness of the Slab
—Materials and Proportions Recommended—Joints—
Curbs—Forms—Placing and Finishing

DRIVEWAYS for filling stations frequently require the construction of several hundred square yards of concrete pavement. They offer a profitable business to the concrete builder who owns a small mixer.

When the driveways are built for one of the larger oil companies, the buyer will probably specify the thickness of slab, proportions of materials and the general layout for the work. If it is a driveway to a privately owned station, however, the contractor may have to advise the owner about the details of construction.

Thickness of Slab

The thickness of concrete in the driveway depends, to some extent, upon the weight of the vehicles that will use it. For ordinary automobiles and for trucks of three tons capacity or less, a 6-in. slab would be sufficient. This thickness is not recommended, however, because it is highly probable that heavier trucks will stop for gas or oil. A 7-in. slab will support a full loaded 5-ton truck so long as the truck wheels do not come within 2 ft. of the edge of the driveway. When it is possible for the wheels to come that close to the edge, then the concrete along the edge should be made 9 in. thick. This thickness can be secured by constructing a curb as a part of the pavement,

if a curb is desired, or by making the subgrade 2 in. deeper along the edge than it is in the interior portion of the slab. If 7-ton trucks are expected the edge of the slab should be 10 in. thick and the interior portion 8 in.; or the whole slab may be made 8 in. thick if it is impossible for truck wheels to get on the edge of the slab because of posts, a curb, or stands for pumps.

If 10-ton trucks are liable to call for gas, the edge thickness should be 11 in. and the interior thickness 9 in. Several oil companies who have stations in Chicago where 10-ton trucks are common, build driveways 9 in. in thickness.

Materials

Materials vary considerably in different parts of the country, but the same general requirements apply to all of them. The first consideration is that they be clean. That usually means that the sand and pebbles must have been washed in a regular washing plant; and that all the dust be screened out of crushed rock. Clean materials are even more important for pavements than for other types of concrete work, because dirt in the aggregate will work to the surface of the slab, where it will form a soft, weak, porous layer which will soon scale off, leaving an

Concrete is wheeled from the mixer to its place on the subgrade. Usually the drive is built half-at-a-time so that vehicles can reach the pumps during construction

Expansion joint material is held vertical by a bulkhead until concrete is placed on both sides of the joint



unsightly surface.

Sand which contains particles ranging from grains which are very small all the way up to those which will just pass a $\frac{3}{8}$ -in. sieve is best. Finer sands can be used but they require more cement to get the same strength, and it is nearly impossible to get good concrete from sands which are extremely fine, like those found in sand dunes and on some lake beaches. Sands which contain a large amount of mica should also be discarded.

Coarse aggregate should be graded from particles $\frac{1}{4}$ -in. in diameter to those having a diameter of about $2\frac{1}{2}$ in. Some engineers and contractors prefer the $1\frac{1}{2}$ -in. instead of the $2\frac{1}{2}$ -in. maximum size, because concrete containing the smaller sized stone is easier to handle. Theoretically, the smaller the aggregate the more cement is required to get the most strength, so it is not wise to use smaller than the $1\frac{1}{2}$ -in. maximum sized stone in pavement slabs, though it might be advisable in a building, where the concrete must be worked into the corners of forms or around closely spaced reinforcement.

Either pebbles or crushed rock will make good concrete, but no "pit run" gravel or mixed aggregate of any sort should be used because it is impossible to tell just what proportions of fine and coarse aggregates are being combined with the cement.

Proportions

Proportions in common use in the United States range all the way from the $1:1\frac{1}{2}:3$ mixture, which means one sack of cement to $1\frac{1}{2}$ cu. ft. of sand and 3 cu. ft. of stone,



Be sure to provide an expansion joint between the pavement and the pump islands

to the $1:2:4$. Of these the $1:2:3\frac{1}{2}$ mix is the most common and is the one recommended for use unless there is some very good reason for selecting other proportions. Leaner mixes, like those sometimes put in concrete bases, wear so rapidly when exposed to traffic that their use in concrete pavements is not economical.

The concrete should be of the same proportions from top to bottom of slab. A top coat of mortar is never advisable unless the only coarse aggregate available is too soft to wear well. A one-course pavement is both

cheaper and better than the two course; cheaper because less labor is required to build it; better because there is no top layer to loosen and come off.

The quantity of water is of as much importance as the quantity of cement, and of even greater importance than the quantity of aggregate. Use just enough water so the concrete can be placed without honeycomb spots and finished without rock pockets in the surface. Very little wa-



For the smaller job, materials are usually measured in wheelbarrows. Accurate measurement can be secured by using a movable partition which can be set in the barrow so that the correct quantity of aggregate is secured when the barrow is level full

ter should come to the surface during the finishing operations. Additional water only weakens the concrete.

High early strength concrete is frequently used when it is desired to open the driveway to traffic sooner than the 10 to 14 days which are usually given concrete to harden properly. The higher strength may be secured by the use of an additional quantity of cement (say a $1:1\frac{1}{2}:3$ mix), a smaller quantity of mixing water (say $4\frac{1}{2}$ gallons to a sack of cement) and a mixing time of from 3 to 5 minutes. During warm weather, such a concrete could be opened to vehicles in 3 or 4 days. Ordinary concrete could be opened to automobiles in 3 or 4 days during warm weather, but trucks should be excluded for at least a week. There are also available some high early strength cements which will permit early opening of pavements with standard proportions.

Reinforcement

Reinforcement, when used, should be placed two inches below the surface of the slab. That makes it necessary to strike off a layer of concrete roughly, at that distance below the final surface, lay the reinforcement in place and then fill in the balance of the concrete.

It is bad practice to lay steel on the subgrade to be pulled up into the concrete after part of the thickness of the slab has been placed above it, as much of the steel never gets off the subgrade at all.

Reinforcement weighing from 35 to 45 pounds per hundred square feet is usually selected for pavement slabs. It should be laid with the heavier wires in the direction of the greatest length of slab and the edges of mats or bars should be lapped several inches, so that stresses may be transferred from one mat to the next.

Reinforcement should not run across transverse joints.

Subgrade

The soil on which the slabs rest should support them

uniformly. If trenches have been cut for sewer, water or other pipes or holes dug in placing storage tanks, the earth in these excavations should be either carefully tamped back into place or, if it is already replaced when the driveway contractor arrives, should be settled by thorough saturation with water. The saturated earth should be allowed to dry as long as possible before concrete is placed upon it. Very heavy clay can not be satisfactorily settled by saturation.

If there are any extremely hard spots in the subgrade, these should be dug up or plowed and the whole subgrade be first made uniformly soft, then be tamped with a hand tamp until it is smoothed out and slightly compacted. If the hard spots are not dug up the slab will rest on them alone, when the softer earth settles slightly, and cracks will form over the hard spots. If the whole subgrade is uniformly hard it need not be disturbed.

Except on the very worst gumbo or adobe soils it is not necessary nor advisable to put a layer of cinders, sand or gravel between the slab and the natural soil.

It is important that the subgrade be smooth because either high or low spots will anchor the slab and prevent its free movement over the subgrade as the concrete expands or contracts. If the slab is too firmly anchored to the subgrade, cracks may form in the concrete in spite of the joints which are put in to prevent such cracking.

The subgrade should have no inequalities greater than $\frac{1}{2}$ in. if anchorage is to be prevented.

Joints

It is advisable to divide concrete driveways into blocks not more than 15 ft. wide and not more than 30 ft. long. The dividing planes between the blocks are called joints and are necessary because concrete expands as it gets hotter or wetter and contracts as it gets cooler or drier. If the joints were not put in, unsightly cracks would form as the slab contracted or the pressure of the expanding concrete might break the slab, push over curbs or damage adjacent sidewalks.

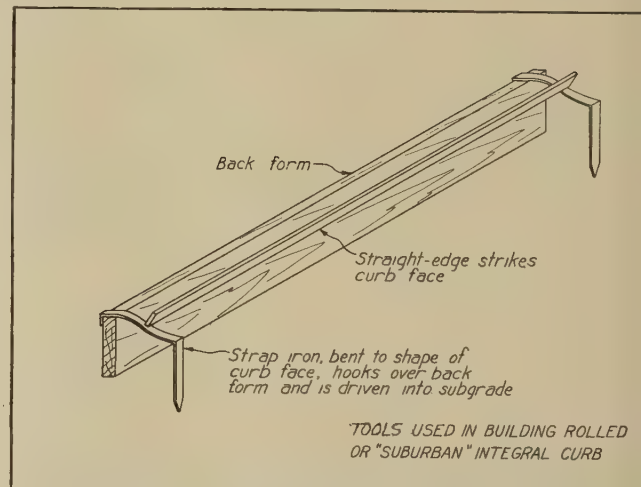
To prevent damage from the expanding concrete an expansion joint should be left around all rigid structures which would otherwise come in contact with the slab. That includes sidewalks, oil pump foundations and the foundation of the station itself. Expansion joints are constructed by placing a strip of premolded joint filler against the rigid structure, holding it in place with wood or metal stakes, and putting concrete against it. The filler should extend to the full depth of the slab. The joint filler is a prepared strip of plastic material between two strips of fibre, like a sandwich. When the concrete expands the plastic material is pushed out, relieving the pressure.

The joints dividing the slab into blocks may be formed by cutting a slot from 2 to 3 in. deep and from $\frac{1}{4}$ to $\frac{1}{2}$ in. wide in the surface of the slab. That can be accomplished by pushing the web of a "T" bar into the partly finished concrete. The "T" bar is usually about 10 ft. long and is mounted on the edge of a plank which has plow handles attached to each end. As soon as the slot is formed it is filled with a strip of premolded joint filler of the proper depth and width and the finishing is completed.

Filling station driveways are not ordinarily long enough to require true expansion joints, other than those around the rigid structures already mentioned. If it is desired to put in other expansion joints they can be constructed by staking a metal or plank bulkhead in place on the subgrade before the concrete is placed. The bulkhead should be truly perpendicular to the subgrade and be held in place by sufficient stakes to keep it in that perpendicular

position while concrete is placed against it. The joint filler is placed against this bulkhead and concrete is put on both sides of the joint before the plank is removed. The bulkhead is lifted slowly, from one end only, as concrete is pushed into the space left by the plank so that the joint filler remains perpendicular to the subgrade. Great care should be exercised to see that no concrete spans an expansion joint at any point. Even though only a half inch plug of concrete crosses the joint, it will cause a spall or a crack, because it will carry all the pressure of the expanding concrete. About 1 in. of expansion space is required for each 100 lineal feet of driveway.

The edge of the slab along all joints should be rounded with an edger having a radius of $\frac{1}{2}$ in. Under no cir-



The only forms required for the flat faced curb suitable for driveways is half a dozen strap irons, bent to the shape of the curb, and a 10-ft. straight edge

cumstances should any concrete, even though it is only a eighth of an inch thick, be left on top of the joint material.

Curbs

Curbs which are cast as a part of the slab itself are better than curbs built separately, because they strengthen the slab. They are also cheaper. These integral curbs, as they are called, can be built with very little equipment, and the face is made flatter than that commonly employed for curbs.

Suppose a curb 4 in. high and having a batter of 1 in. vertical to 2 in. horizontal is desired. If the top of the curb, at the back, is made 2 in. wide then with the suggested batter the face of the curb will meet the slab 1 in. from the back of the curb.

For such curb, all the construction equipment that is required is about 6 strap irons and a 10-ft. straight edge. The strap irons are bent to the shape of the face of the curb, and have one end bent into a right angle, to hook over the form, while the other is also bent at a right angle and made long enough to be driven 3 or 4 in. into the subgrade. (See illustration.)

These strap irons are set along the edge at 10-ft. intervals before concrete is placed, using the carpenter's level to get the outer end at the proper elevation for the flow line of the gutter. When concrete is deposited for the slab enough is left along the form to make the curb. The face of the curb is then struck off with the straight edge, whose ends rest on the strap irons, which are then removed. The final finish is given the curb with a wooden hand float.

Curved curb of this same shape can be formed with a tool like a hand float, but cut to the shape of the curb

This float, or "mule" as it is usually called, is built to mold the curb into the proper shape as the mule is drawn along with one edge on the back form.

All joints in the slab should always extend through the curb.

Forms

Most filling station driveways are curved throughout most of their length. That makes it necessary to use forms which can be bent to the shape of the curve. Usually half-inch boards are used in such places, and are backed by sufficient stakes to hold them rigid. Two-inch planks are good for the straight forms.

It is customary to have the driveway come flush with the sidewalk. If the sidewalk is not yet built, the established grade for the walk should be secured from the city engineer before either the driveway or the station is started. The driveway at the pumps should be far enough above the walk so that water will drain toward the walk and into the gutter, unless catch basins are put in the drive and the water is carried from them to the gutter by a tile drain. Concrete can be made to drain properly with a slope of $\frac{1}{4}$ in. per foot, if it is finished carefully, but a half-inch is better.

The side forms are set to the slope selected or to give a gradual slope from the high points to the low points, if these have already been fixed. The proper slope may be determined by an architect's or engineer's level, if one is available, or by a carpenter's level with a block of the proper dimensions under one end, or by sighting over the tops of three stakes of exactly the same length. These three stakes or "T's" as they are usually called, can be used to set a uniform slope between two points by holding a "T" on each of the points and the third "T" on the point which it is desired to have on a straight grade between them. By sighting over the tops of the 2 "T's" the amount that the intermediate point is above or below a straight grade between the other two points can easily be determined.

Forms should be firmly bedded on the undisturbed earth, if possible, or upon well compacted earth, so that they will retain the proper grade during the construction operations, and should be so well staked and braced that the pressure of the concrete will not move them.

Straight forms are set from a chalk line which is tied at the proper elevation and alignment for the forms. It is best to set the chalk line half an inch above grade, then measure down half an inch in testing the forms, because if the line is set at the exact grade it can not be kept "free."

Curved form alignment is determined by eye, except when the curve is the arc of a circle, in which case it is given by pivoting a tape measure or board from the center of the circle. An even slope for curved forms, between points of known grade, is usually determined by the carpenter's level.

It is customary to stake and brace forms at the end of each plank and at about 6-ft. intervals between. The stakes are all set on the outside side of the forms and, in soft soil, are braced to shorter stakes driven nearly flush with the ground and about 2 ft. away. Forms are nailed to the stakes but nail heads are left protruding slightly, so that the nails can be drawn out when the forms are removed.

Mixing

Concrete should be mixed in a batch mixer for at least one minute. A shorter mixing time reduces the strength, partly because of less intimate contact between cement and aggregate and partly because more water is required to get the same workability. A one minute mix does not

mean a batch a minute; it means that all the materials should be actually turned in the drum for a full 60 seconds.

Placing the Concrete

Concrete should be placed continuously, one batch following another with, at most, only a few minutes interval between batches. When the mixer is to be stopped for 30 minutes or more it is essential that a bulkhead be put in to form a square butt joint, because if a ragged edge is left, a cleavage plane will result and a ragged, ugly crack will later form. When the mixer is started after a stop of 15 or 20 minutes, the new concrete should be mixed into the edge of the old, by slicing or shoveling them together.

Even a plastic and workable mix will not result in a well filled, smooth surface along the forms unless special attention is given the concrete at that point. It is, therefore, customary to "spade" the concrete along all forms and along joints. That is accomplished by working a spade up and down in the concrete, holding the back of the spade against the form.

Finishing

The contractor's whole job is judged by the appearance of the finished driveway, so it is extremely important that this part of the work be well done. The surface should be made true and even, free from rock pockets or other blemishes, and the corners at the edge of the slab and at joints should be rounded with an edger having a radius of $\frac{1}{2}$ in.

The first operation is striking off the surface. That is done with a template which may be either a straight edge, for flat slabs, or slightly curved, to form a crowned slab. The straight edge will usually be best for filling station drives. The template should be heavy, weighing as much as 10 pounds per foot of length, and should be long enough to span the drive and rest on the forms. The newly deposited concrete is struck off with this template and may then be tamped with the same template, until practically all the coarse aggregate is submerged.

The surface is further smoothed and all rock pockets are filled by a board float about 6 ft. long attached to a handle 10 to 12 ft. long, operated by one man who stands near the edge of the slab.

The final finish is given by a canvas or board belt about 2 ft. longer than the width of the slab. This is laid on the surface of the concrete immediately following the long handled float and is dragged forward with a sawing motion. Sometimes a final finish is given by dragging a strip of burlap over the concrete just before it begins to look a little dry.

Too much finish is detrimental, so finishing should be stopped just as soon as the desired surface is secured.

Protection During Hardening Period

If concrete is allowed to dry out before it has completely hardened it has considerably less strength than it would have if kept wet, and the shrinkage following rapid drying may result in surface cracks. To avoid these things the concrete should be covered with wet burlap just as soon as the burlap can be put on without damaging the surface. The burlap is then kept constantly wet until the slab is opened to vehicles; or the burlap may be replaced by a 2-in. layer of earth or 6 in. of hay or straw, which are kept wet until the driveway is put into use. Keeping the slab wet while it is hardening is especially desirable for filling station drives because then the slab is much less liable to absorb oil drippings.

The driveway should, of course, be fenced off during the curing period so that its surface can not be marred by footprints or its corners be cracked off by vehicles.

Solid Slab Concrete Reinforced Floors

(Continued from page 38)

forcing, as this is commonly called, is always placed at right angles to the main reinforcing steel to provide for stresses due to temperature changes and shrinkage.

Form Construction

Simplicity is a primary requirement in form construction for solid slab reinforced concrete floors. Forms must be strong enough to carry safely the weight of the concrete plus the live-load which must be sustained during concreting. Durability is also essential as forms should be able to withstand hard and repeated usage. Economy of construction and material, consistent with strength, is also desirable. To prevent seepage through cracks, it is important that forms be close-fitting. Seepage causes ridges and honeycombing which can be eliminated by proper form construction.

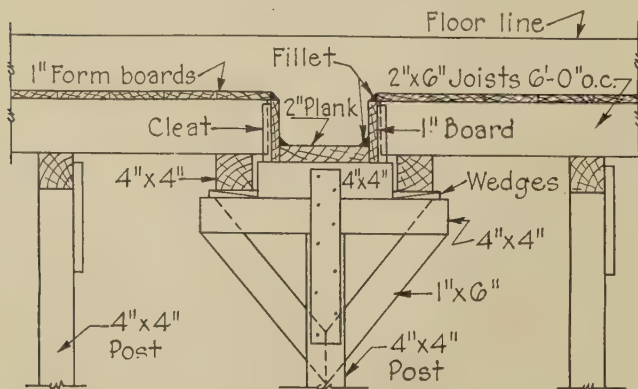
Economy in erecting and stripping are other important considerations. However well a form may be built, its ultimate success depends upon the speed and ease with which it can be stripped. Further economy is effected by designing forms so that the lumber can be used again.

Lumber for Form Work

The dimensions of lumber should be chosen to carry safely the weight of the concrete, the reinforcing steel and the construction load. Any good, sound lumber, free from knots and decay is suitable. The use of sheathing dressed on one side and both edges facilitates removal of forms. Where smooth, true surfaces are required, the lumber should be dressed on all four sides. Tight joints may be obtained by using tongue-and-grooved stock or shiplap.

Thickness of lumber depends somewhat upon the number of times the forms will be used and, in the case of forms for solid slab floors, on whether the boards are to be built into panels or nailed each time to the supporting timbers. To minimize waste, lumber for column and beam forms should be bought in the nearest commercial length to the height or span required.

The sizes of lumber most frequently used in form work



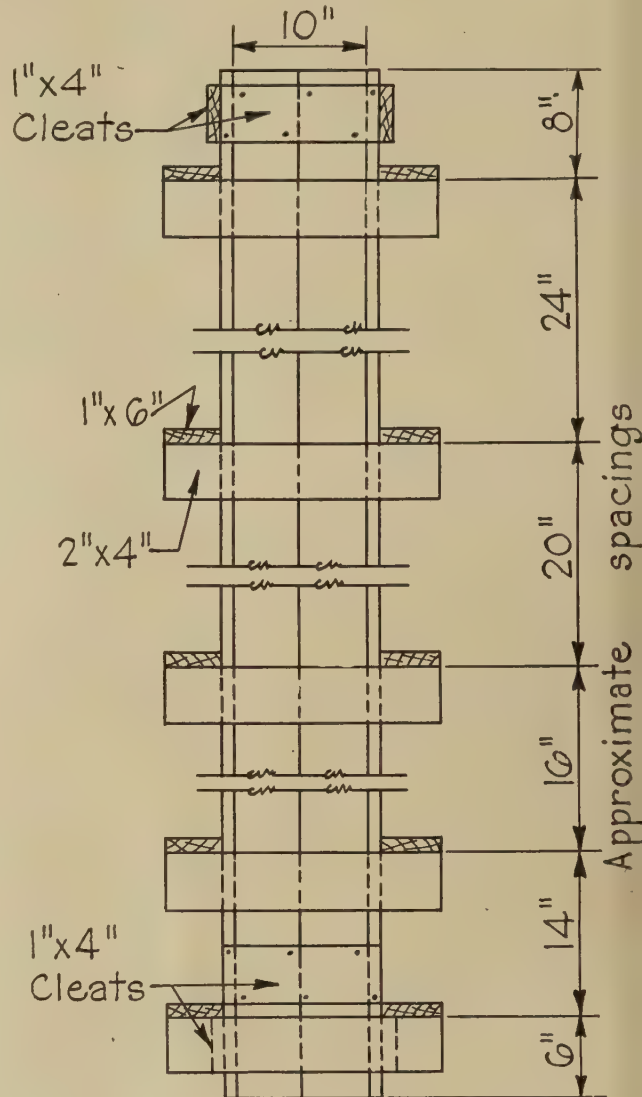
Cross section of a beam form for a solid slab floor

for concrete floors are as follows: 1-in. stock for floor, forms, columns and beam sides; 2-in. stock for beam bottoms; 2- by 4-in. stock for column yokes; 2- by 6- or 2- by 8-in. stock for stringers and joists; 3- by 4- or 4- by

4-in. stock for posts, struts, shores, uprights and some times for stringers; 1- or 2-in. stock for cleats; and 1- by 6-in. stock for cross ties and similar bracing.

Form Accessories

Where several concrete floors are to be built with the same set of forms, it is usual practice to procure adjust-



Spacing of yokes on typical column form

able shores and column clamps. The use of these devices effects a saving in form lumber as well as in carpenter work. Double-headed nails are frequently used because they can be withdrawn easily when stripping the forms or when salvaging form lumber.

Conduits, Pipes and Openings

It is important that the work of electrical, plumbing and heating contractors be properly scheduled to the mutual advantage of these trades and the builder of the concrete floor. Their work, insofar as the floor is concerned, ordinarily should be completed before any concrete is placed.

All conduits or pipes should be so located as not to reduce the strength of the construction. Where structural concrete floors are to be surfaced with wood flooring, pipes or conduits usually are placed between the sleepers. When other types of floor finishes are to be used, conduits

or pipes are placed in the bottom of solid slab floors, usually just above the reinforcing steel.

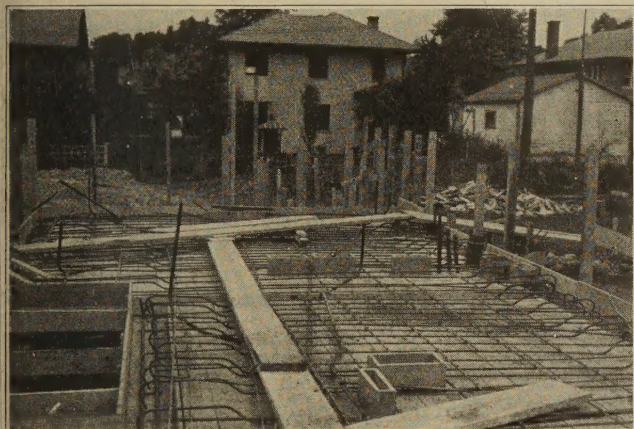
Wood generally is used for forming square or rectangular openings in concrete floors; sheet metal is used for round or curved openings.

Foundation Walls and Footings

Either concrete masonry or monolithic concrete foundation walls, as ordinarily built, will support concrete floors equally well. However, where the floor is supported on a concrete masonry wall it is customary to fill the core spaces in the top course with concrete to provide a substantial support for the slab and to distribute the weight uniformly to the wall. Concrete floors should have a minimum bearing of 5 in. on the wall. If the wall is 12 in. thick, 7-in. bearing of the slab usually is provided.

Air Space Insulation

A vertical air space about 1 in. wide, as shown in the Longitudinal Section, should be provided between the edge of the concrete floor slab and the outside masonry. This air space acts as an insulator, preventing heat and cold from being transmitted through the slab. The edge of the slab is formed by a 2- by 8-in. plank placed in an upright position on the foundation wall, at a distance from the inside of the walls equal to the proposed bearing width.



Forms completed and reinforcement placed, ready to receive the concrete. Note the provisions made in the form work in the foreground to provide openings through the floor

The plank should be well anchored to prevent the concrete from pushing it outward. Metal or wire ties usually are used for this purpose.

It is common practice to place monolithic concrete footings for columns and bearing walls which support concrete floors. The footings should be made wide enough to spread the entire load over sufficient area to be safe against settlement.

Concrete for Floors, Beams and Columns

For solid slab reinforced concrete floors and for beams and columns, concrete which attains a compressive strength of not less than 2,000 lb. per sq. in. at 28 days is required. The approved mix is one containing $7\frac{1}{2}$ gallons of water (with aggregates that are thoroughly dry) or each sack of cement. Use 6 gallons with moist aggregates and 5 gallons if aggregates are dripping wet. As a trial batch combine 1 sack cement, $2\frac{1}{2}$ cu. ft. sand and $\frac{1}{2}$ cu. ft. coarse aggregate, using quantities of water specified. If this mixture is too wet, add more sand and coarse aggregate; if too stiff, use less aggregate in succeeding batches. Do not vary the amount of water from the amounts specified.

Placing Concrete in Forms

After the concrete has been mixed thoroughly, it is deposited in the forms in a continuous operation. The concrete should not be so stiff that it requires excessive puddling to get it to settle into the forms. The concrete should be thoroughly worked around all reinforcement, around embedded fixtures, and into the corners of forms. It is well to complete the work in one day's operation, if possible, to avoid construction seams. Concrete floors should be placed the full thickness and concreting should progress parallel to main reinforcing steel. If it is necessary to stop work, construction joints in floors should be located near the middle of spans and at right angles to the main reinforcing steel. At least two hours must elapse after depositing concrete in the columns or walls before placing concrete in beams or slabs supported thereon.

Removal of Forms

Forms usually may be removed as soon as the concrete has hardened sufficiently to be self-sustaining. When the temperature is above 60 degrees F., the minimum for removing forms after placing concrete should be as follows:

Forms for footings, basement walls or foundations, 1 day; forms for sides of beams, 2 days; column forms, 3 days; forms for floor slabs of spans up to 16 ft., 4 days.

When the forms are removed, supports or shoring should be replaced immediately and remain under floor slabs at least 2 weeks; under beams, at least 3 weeks. Supports or shoring under floors or beams carrying the load of subsequent building operations should remain in place at least 2 weeks longer than specified in the foregoing schedule.

Replacing of Supports or Shores

When the temperature is below 60 degrees F., the forms and supports should be left in place a longer period. Ordinarily, one week is sufficient extra time for cold weather work.

Curing Concrete Floors

It is recommended that structural concrete floor slabs be kept continuously wet for at least 10 days.

Simplified Wheelbarrow Sizes Approved at Meeting

A schedule for simplified sizes and types of wheelbarrows was approved at a general conference of manufacturers and users of wheelbarrows held by the Division of Simplified Practice at the Department of Commerce, Washington, D. C., on April 26th.

In addition to approving the program, the conference voted that all contractors' barrows shall be rated and catalogued according to struck capacity, to insure accuracy when the barrow is used as a measuring device.

Permanent Improvements Best

When rebuilding or renovating, it is best to make permanent improvements. For modernization, to be real, must involve attention to fundamentals. Foundations, basement floors, bearing walls, firestops, footings for foundations—these and other more or less hidden elements must be considered before the final and apparent changes are undertaken. The best policy is—build soundly within and without. Judicious use of concrete and concrete products, it has been found, makes possible modernization on a sound structural basis, thereby eliminating the speculative element in the modernized house market.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Michigan.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 W. Grand Ave., Chicago.

American Construction Council; Dwight L. Hoopingarner, Executive, 28 W. 44th St., New York City.

American Engineering Standards Committee; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth St., New York City.

American Road Builders' Association; Miss E. A. Birchland, Secretary, 29 W. Thirty-ninth St., New York City.

Twenty-seventh annual convention and road show, January 11th to 18th, 1930. Atlantic City, New Jersey.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 W. Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

Associated General Contractors of America; D. H. Sawyer, Secretary, 1150 Munsey Bldg., Washington, D. C.

Cast Stone Institute; Frank M. Brooks, Secretary, Pasadena, Calif.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Iowa Concrete Products Association; R. L. Gavin, Secretary-Treasurer, 1002 Hubbell Bldg., Des Moines, Iowa.

National Association of Builders' Exchanges; Earl F. Stokes, Secretary, 15 E. Fayette St., Baltimore, Md.

National Concrete Products Association; A. G. Swanson, Secretary, Omaha, Nebr.

National Crushed Stone Association; J. R. Boyd, Secretary, 751 Earle Building, Washington, D. C.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N.W., Washington, D. C.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 432 Munsey Building, Washington, D. C.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Building, Cleveland, Ohio.

Northwest Concrete Products Association; W. P. Hews, Yakima, Wash.

Ohio Concrete Products Association; G. M. Friel, Secretary-Treasurer, 2284 North High St., Columbus, Ohio.

Portland Cement Association; William M. Kinney, General Manager, 33 W. Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Building, 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 3115 Plankinton Arcade, Milwaukee, Wisconsin.

The Concrete Industry —25 YEARS AGO

THE Baltimore fire still seems, in July, 1904, to be the topic of greatest interest to engineers, for that issue of *Cement Age* carries two feature articles on the subject. One is a report on the fire submitted to the Insurance Experiment Station by Prof. Chas. L. Norton. The other article, also by Prof. Norton, reports a fire test made on a "concrete steel floor."

It is interesting to note the statements made by Edward Atkinson, director of the Insurance Engineering Experiment Station, in his introduction to Prof. Norton's report.

Mr. Atkinson said: "Well made concrete encasing steel proves to be most fully a fire resistant when it is made with true portland cement rammed and tamped in the proper manner. It fortunately happens that a well made concrete of this kind is subject to a law of expansion and contraction under heat so nearly identical with that of steel as to assure its position being maintained under higher and varying temperatures. It will be remarked that the temperature in this conflagration must have reached a higher point in many of the buildings of ordinary construction than it did in the steel-framed buildings. In the former many examples of melted iron and steel were found; in the latter, few traces of a temperature reaching these melting points."

—†—

IN these days when the elimination of the human equation in cement testing is the object of a definite program, it is interesting to know that twenty-five years ago the same subject was under discussion. An article, published under the title "Some Attempts to Limit the Personal Equation in Cement Testing," and written by W. A. Aiken, appeared in the July, 1904, issue of *Cement Age*.

Mr. Aiken describes a briquette testing method that he adopted after several years of experimenting. He called this the "dry" method, because he filled the gang molds with three layers of dry cement, the two lower layers being tamped by three blows of a wooden mallet. The top layer was simply pressed in and smoothed off. After the briquettes were made in this manner, they were put into storage tanks and permitted to take up as much water as required. It was found that 22 per cent of water (by weight) was taken up by the briquette.

Mr. Aiken claims that this method of making briquettes reduced the personal equation due to varying the amounts of water, and differences in the moulding of the briquettes by thumb pressure. He found that the briquettes made by the "dry" method just described showed a more pronounced gain in uniformity when tested than did the briquettes made in the standard way.

It is interesting to note, also, that the "dry" briquettes showed consistently higher strengths at all periods. There was a marked difference in the rate at which the strength was gained. Standard briquettes gained 11 per cent in strength between the 7 and 28 day tests, while "dry" briquettes gained 20 per cent in strength during the same period.

Mr. Aiken concludes that: "Examination will show that in every instance the 'dry' method briquettes show the greater strength at every period, and while the figures shown are averages, the uniformity of results in individual lots as referred to is marked so that in most instances the lowest 'dry' break is as good as the highest 'wet' break."



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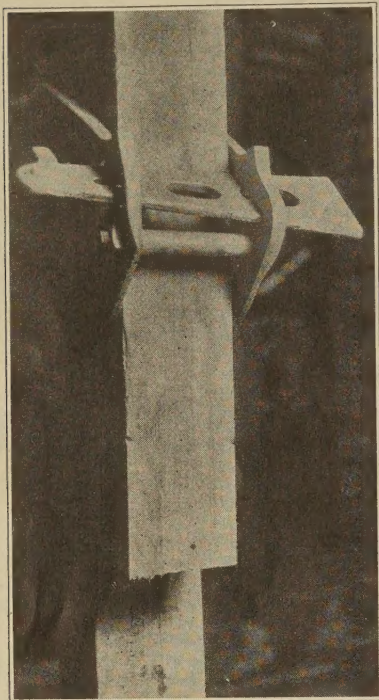
STEEL - SERVICE

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New Equipment and Materials

Application of New Bosco Shores Illustrated

Bosco shores, shown in actual use in the accompanying illustration, are locked or released with one blow of the hammer, the manufacturer states. Final adjustment is made with a simple level jack. No wedges are used and 3000 lbs. may be



carried without deflection, it is said. The steel lock wedge is assembled into the frame and is not detachable.

The Bosco Building Products Company, Chicago, Ill., manufactures the Bosco shore.

Crawfordsville Unit Produces Shingle Tile

The Crawfordsville Machinery Company, Indianapolis, Indiana, has recently completed the finishing touches on a new roof tile machine producing a unit that lays like slate or wood shingles and with the thick butt-end of a concrete tile but minus the accompanying weight.

The tile have thick-ribbed sections on the bottom, giving them unusual strength as well as partitioning off numerous air spaces on each unit. In addition to providing insulation, this feature allows the nail-head to protrude $\frac{1}{4}$ in. from the surface without having a bearing on the overlapping tile above.

The Crawfordsville power press is a heavy duty machine said to be capable of

high speed production. A motor-driven material feeding mechanism distributes an even fill over the surface of the pallet. The aggregate is then tamped into position by a moving set of small tampers. A final 200-ton blow from the machine compresses the tile and punches the nail holes. The finished tile is automatically ejected at the up stroke of the ram.

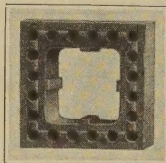
Air-Cooling Principles Employed by Engine

The New-Way Motor Company, Lansing, Michigan, has developed a "Twin-Cylinder" engine employing air-cooling principles. It is a valve-in-head type, with detachable cylinder head. There are no water pipes, radiator fins, or other parts associated with water-cooling. It is available in from six to ten horsepower.

A large inspection plate may be removed, exposing all moving parts and through which pistons may be removed with ease. Roller bearings, air-governor, Eiseman special flywheel magneto, Tillotson float feed carburetor and air cleaner and Lignite connecting rods are standard equipment.

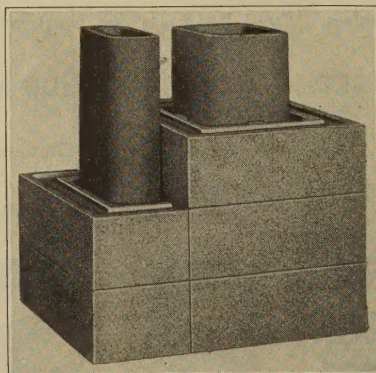
Multiplex Flue Block

Shown below are two views of the flue block produced on equipment furnished by the Multiplex Concrete Machinery Company, Elmore, Ohio.



One shows the single unit and the other the flue laid up with a whole and a half block.

These illustrations, instead of the one that appeared in the May issue, in these columns, should have been shown with



the item describing the Multiplex safety flue block.

Notes from the Field

Concrete Equipment Becomes Colorcrete Industries

So that concrete products manufacturers may capitalize on the popularity of color in units, the *Concrete Equipment Company* has merged itself with the *Colorcrete Industries*, both of Holland, Michigan.

Colorcrete is described as being the trademarked name of a process for producing a complete line of masonry products in colors and textures.

J. E. "Jack" Lang, formerly general manager of the Raber & Lang Mfg. Co. of Kendallville, Indiana, has joined the Colorcrete Industries in the capacity of industrial manager.

It is felt that with the application of color to concrete products of all kinds made possible by this change, a definite contribution has been made not only to the improved appearance of the latter but to their sales possibilities and to the returns of those who manufacture them, as well.

American Hoist Branches Move

June 1st was moving day for the Chicago and Pittsburgh branches of the *American Hoist & Derrick Co.* of St. Paul. The Chicago office, which has been located at 1113 Fisher Building, has moved to 1000 Engineering Building, at 205 W. Wacker Drive. The Pittsburgh branch is now located at 901 Farmers Bank Building instead of 604 Chamber of Commerce Building.

Industrial Literature

Grid System Structures

Two new publications received from the *Grid Flat Slab Corporation*, Boston, Mass., are the "*Church Bulletin*," *Showing the Grid System of Reinforced Concrete Construction*," and the "*School House Bulletin*." Both show excellent views of their respective type of structures employing the Grid system—a form of construction for floors and roofs, made upon removable steel domes, which leaves hollow squares in the underside.

Lewis-Shepard Publication

A stacker edition of its "*Jacklift and Stacker Practice*" broadside is received from the *Lewis-Shepard Company*, Watertown Station, Boston, Mass.

It presents excellent illustrations and relevant data on a number of models. Uses to which the equipment may be put are suggested by additional illustrations.